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The effect of aloe vera juice on Aloksan-induced reduction of blood sugar of mice

Nabila Rahma Khaerunnisa [1], Tania Ardiani Saleh [2,*], Citrawati Dyah Kencono [3] and Sundari Indah Wiyasihati [4]

[1] *Medical program, Faculty of Medicine, Airlangga University, Surabaya, Indonesia.*
[2] *Department of Histology, Faculty of Medicine, Airlangga University, Surabaya, Indonesia.*
[3] *Department of Medical Physiology and Biochemistry, Faculty of Medicine, Universitas Airlangga, Surabaya, Indonesia.*
[4] *Department of Pharmacology, Faculty of Medicine, Universitas Airlangga, Surabaya, Indonesia.*

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Abstract

Aloe vera is one of the plants that has many properties. One of the widely used Aloe vera preparations is processed into Aloe vera juice which has benefits for the body if consumed. One of the benefits of Aloe vera juice can lower blood sugar in the body due to the phytochemical content contained therein such as flavonoids, glucomannan and vitamins**.**

Objective: Analyzing Aloe vera juice at doses of 200 mg/KgBB, 300mg/KgBB and 400mg/KgBB in lowering blood sugar and seeing the most effective dose in mice injected with alloxan.

Methods: Quantitative research conducted by experimental methods in vivo on Mus musculus mice with post test control group design. Results: Kruskal-Wallis test analysis on blood sugar reduction showed a significant decrease in the group given Aloe vera with a p value of 0.015 ($P < 0.05$).

Conclusion: Aloe vera at a dose of 400mg/Kg BB is proven to reduce blood sugar in mice induced by alloxan.

Keywords: Aloe vera; Juice; Alloxan; Blood sugar; Hyperglycemia

1. Introduction

Aloe vera is a medicinal plant that has been popular since ancient times because it has many properties for the treatment of diseases. This medicinal plant can be used because it is relatively safer, easy to find and cheaper compared to synthetic drugs in the market. Aloe vera has been used by different cultures such as Egypt, India, China and European cultures for more than 5,000 years because of its amazing medicinal properties. The use of Aloe vera is very broad in its benefits, because it can be used into a variety of products ranging from cosmetics to medicines. Aloe vera has also become popular for making various processed foods and drinks, one of which is processed into Aloe vera juice. The results of the use of Aloe vera also show a positive impact on lipid, carbohydrate metabolism and immunoregulatory properties [1].

Aloe vera has many benefits in medicine that many people may not know about. Some of these benefits are anticancer, antimicrobial, anti-aging, anti-inflammatory, immunomodulatory and hepatoprotective. Aloe vera is one of the plants that has the most effective bioactive content because it has 75 nutrients and 200 bioactive components. The gel of Aloe vera is the part that contains parenchyma cells which are reservoirs of many phytochemicals including polysaccharides, amino acids, enzymes, glucomannan, lipids, sterols, vitamins, flavonoids, alkaloids, anthraquinones, anthones, coumarins, chromones and pyrones [2]

* Corresponding author: Tania Ardiani Saleh

Aloe vera is one of the plants used in reducing blood sugar in hyperglycemic patients. Hyperglycemia is characterized if the fasting blood sugar is 125mg/dL and if untreated will become a chronic disease resulting in various microvascular and macrovascular complications. Aloe vera juice is an alternative treatment for patients experiencing hyperglycemia. Compared to modern conventional therapies that have side effects that result in lack of patient compliance in carrying out therapy, Aloe vera juice is proven to have minimal side effects compared to modern conventional drugs on the market [3]. Based on the theoretical background above, researchers are interested in conducting research on Aloe vera juice against hyperglycemia mice. Researchers also want to know the most effective dose to reduce blood sugar from hyperglycemia mice.

2. Material and methods

This type of research is quantitative research conducted with experimental methods in vivo on mice Mus musculus. This research design uses a posttest control group design, by randomizing mice samples in five groups. The sample used in this study was 5 mice per group plus a 20% mortality factor so that each group contained 6 mice or the total used was 30 mice. The variables in this study are: alloxan, Aloe vera juice, blood sugar levels and beta cells. This study was conducted from March 2024 to May 2024 in the pharmacology lab of the Faculty of Medicine, Airlangga University.

3. Results

3.1. Differences in Fasting Blood Sugar Levels between Treatments

Based on the table above, it can be seen that the highest reduction value was obtained from the hyperglycemia group with a dose of 400mg / kgBB followed by a dose of 300mg / kgBB and a dose of 200mg / kgBB. This decrease is directly proportional to the higher the dose given, the higher the decrease value.

Table 1 Differences in Fasting Blood Sugar Levels between Treatments

Group	**Fasting Blood Sugar (mg/dL)**			**Decrease**
	Week- 0	**Week -1 evaluation**	**Week -2 evaluation**	
Normal	97±20.21	70.4±7.76	79.8±18.89	17.2±27.66
Hyperglycemi	140±13.26	154.6±33.60	138.8±24.47	1.2±27.83
Hyperglycemi + Aloe vera 200 mg dosage	162.2±38.32	62.2±10.18	82.2±23.43	80±44.92
Hyperglycemi + Aloe vera 300 mg dosage	183.8±104.53	80.4±32.16	73.6±15.75	110.2±105.71
Hyperglycemi + Aloe vera 400 mg dosage	237.6±98.44	118.6±32.30	103±15.24	134.6±99.61

3.2. Kruskal-Wallis Test and Mann-Whitney Test Sample Fasting blood sugar reduction

The decision result based on the p value is if the p value > 0.05, then H0 is accepted, but if the p value < 0.05, then H0 is rejected. Based on the table above, it shows that there are four groups that have the highest GDP reduction, namely the hyperglycemic group - hyperglycemic group with a dose of Aloe vera 200mg, hyperglycemic group - hyperglycemic group with a dose of Aloe vera 300mg, normal group - hyperglycemic group with a dose of Aloe vera 300mg, hyperglycemic group - hyperglycemic group with a dose of Aloe vera 400mg, and normal group - hyperglycemic with a dose of Aloe vera 400mg/kg BW.

In the implementation of GDP research in the pharmacology laboratory, the five groups tested by Mann-Whitney resulted in the decision that the group that reduced the blood sugar of mice the most was in the group of hyperglycemic mice given a dose of Aloe vera 400mg.

Table 2 Kruskal-Wallis Test and Mann-Whitney Test Sample Fasting blood sugar reduction

Group	**Kruskal-Wallis test p value**	**Mann-Whitney test p value**
Normal group – Hyperglycemic group	0.015*	0.347
Hyperglycemic group – Hyperglycemic group + Aloe vera 200mg dosage		0.047*
Normal group – Hyperglycemic group + Aloe vera 200mg dosage		0.076
Hyperglycemic group – Hyperglycemic group + Aloe vera 300mg dosage		0.016*
Normal group – Hyperglycemic group + Aloe vera 300mg dosage		0.028*
Hyperglycemic group - Hyperglycemic group + Aloe vera 400mg dosage		0.048*
Normal group – Hyperglycemic group + Aloe vera 400mg dosage		0.021*
Hyperglycemic group + *Aloe vera* 200mg/kgBB – Hyperglycemic group + Aloe vera 300mg dosage		0.917
Hyperglycemic group + *Aloe vera* 200mg/kgBB – Hyperglycemic group + Aloe vera 400mg dosage		0.347
Hyperglycemic group +*Aloe vera* 300mg/kgBB – Hyperglycemic group + Aloe vera 400mg dosage		0.754

4. Discussion

Alloxan is an organic compound and is a cytotoxic glucose analog used to induce diabetes mellitus. The mechanism of alloxan specifically inhibits pancreatic glucose-induced insulin emission in beta cells and also induces the formation of reactive oxygen species (ROS) which creates a redox cycle and produces superoxide radicals [4]. This damage to pancreatic beta cells causes insulin to not be produced normally by the body, which in turn prevents glucose in the body from being converted into energy and causes high blood sugar levels [5].

The decrease in blood sugar in the administration of Aloe vera is due to the presence of several active compounds in it. Some of the active ingredients contained in Aloe vera such as phenols, flavonoids, vitamins C and E, these components have strong antioxidant properties that defend endogenous oxidative cells and fight tissue damage. Flavonoids are compounds that have been widely associated with various health benefits, especially in the types of quercetin, kaempferol and aloe-emodin which are widely found in Aloe vera. This is due to their antioxidant and anti-inflammatory properties. Regulating the function of key cellular enzymes and scavenging free radicals directly is how flavonoids protect against cell damage [6]. Flavonoids also play a role in increasing antioxidant enzyme activity and are able to regenerate beta cells in maintaining cell damage and then improve insulin receptor sensitivity. Flavonoids will increase the expression and activation of AMP-activated cellular proteins, reduce cellular apoptosis by suppressing capase 3 and increase insulin production and secretion from beta cells [8]. The increase in AMP will make AMPK become active. With this activation AMPK will regulate fat metabolism in the body and regulate carbohydrates in several mechanisms so that it will reduce blood sugar in the body [9].

Acemannan is also the polysaccharide responsible for its mucilaginous properties and has been reported to have anti-diabetic properties as well as the ability to modulate immune function. According to Jales et al. 2021 carbohydrate composition of polysaccharides hydrolyzed with sulfuric acid, mannose was the dominant composition in all fractions representing 55-75% of the total monosaccharides determined [10]. This mannose residue is likely derived from acemannan. Research shows that acemannan in Aloe vera regulates glucose metabolism in diabetic rats by activating glycogenesis and inhibiting gluconeogenesis. Acemannan can also inhibit inflammatory cytokines and inhibit apoptosis by inhibiting the expression of pro-inflammatory cytokines such as IL-1β, IL-6, and TNF-α and then help reduce the expression of apoptotic proteins such as capase 3 which plays a role in programming cell death, thus protecting pancreatic beta cells from apoptosis [11].

5. Conclusion

Aloe vera juice was shown to significantly reduce fasting blood sugar in hyperglycemia mice. This study shows that of the three doses tested, the most effective Aloe vera juice in reducing fasting blood sugar is at a dose of 400mg / kgBB.

Compliance with ethical standards

Disclosure of conflict of interest

We have no conflicts of interest to disclose. All authors declare that they have no conflicts of interest.

Statement of ethical approval

The in vivo test use mice that have previously gone through an ethical test from the Ethics Commission, Airlangga University with an ethical number 78/EC/KEPK/FKUA/2024.

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