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RESEARCH **Open Access**

Aloe Vera: Potential to Reduce Fasting Blood Sugar Levels in Prediabetes

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Abstract

Prediabetes is a continuous spectrum of developmental stages before a person is diagnosed with diabetes mellitus. Considering the long-term effects of pharmacological treatment, other natural-based methods are needed. The purpose of this study was to analyze the effect of Aloe Vera Juice on the reduction of fasting blood glucose levels in patients with prediabetes in Pontianak City. A pre and post-test design study was conducted between March and July 2021 at Alianyang Public Health Center. A total of 12 subjects were identified as prediabetic at the beginning of the study through screening involved in this study. The included subjects were asked to consume 175 ml of Aloe Vera Juice for 15 consecutive days and measured their fasting blood glucose (FBG) levels on the 16th day. A paired t-test was performed to determine the difference in FBG levels before and after the treatment. Present findings revealed that the mean FBG level before intervention was 107.4 mg / dL and 92.1 mg/dL after the intervention. A statistically different FBG reduction significance was found between groups ($p<0.001$). Consuming Aloe vera juice regularly for 15 days has proven to lower FBG levels among prediabetics. Future studies with better adherence monitor and larger sample sizes might have resulted in better determination of the intervention's effect.

Keywords: Prediabetes, Fasting Blood Sugar Levels, Aloe Vera Juice

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1. INTRODUCTION

Diabetes mellitus is a chronic disease characterized by the body's inability to metabolize carbohydrates, fats, and proteins. It is estimated around 422 million people worldwide have diabetes and 1.5 million deaths are directly attributed to diabetes each year (WHO, 2023). Additionally, WHO also predicts that there will be an increase in cases of type 2 diabetes mellitus, reaching 21.3 million in 2030 (PERKENI, 2015). In Indonesia, the average prevalence of diabetes mellitus reached 2.0% at the age of >15 years, while particularly in West Kalimantan Province reached 1.62% for ages > 15 years (Kementerian Kesehatan Republik Indonesian, 2018). These figures are posing a significant global challenge.

Epidemiological studies have shown that genetic inheritance and epigenetic mechanisms, nutritional factors, and sedentary lifestyle influence the risk and complications differently in both sexes (American Diabetes Association, 2018; Ciarambino et al., 2022). A wide variety of lifestyle contributors are a sedentary lifestyle, physical inactivity, smoking, and alcohol consumption (Lee et al., 2018). In most cases, blood glucose levels increase with age, and lead to other complications. Therefore, self-management of glycemic control may be prioritized.

Recently, the majority of the treatment for diabetes is a pharmacological approach (Taylor et al., 2021). The wide range of this treatment prioritizes drug therapy. However, those medications may have dangerous long-term effects, including the risk of liver dysfunction and cardiovascular disease (McMillan et al., 2018; Tziomalos et al., 2011). Thus, other alternative methods with fewer side effects, such as consuming herbal plants are a better method.

Among several herbal preparations, Aloe vera is a plant with medicinal properties and has been scientifically studied in modern medicine (Kurniawaty, & Yanita, 2016). Its biological activities and chemical components, including flavonoids, saccharides, polyphenols, anthraquinones, chromone, phytosterols, proteins, and trace minerals contributed significantly to reducing blood glucose (Babu et al., 2021). Flavonoids have been linked to anti-diabetic potential. These also supported the claim of a previous systematic review study that consuming Aloe vera as a supplement significantly lowered blood glucose (46.6 mg/dL) and reduced HbA1c at 1.05% (Dick et al., 2016).

Aloe vera is widely planted in Kalimantan and constitutes one of Pontianak's leading commodities having the uniqueness and characteristics of West Kalimantan Province. Considering the abundance of this plant and its positive impact on glycemic control, this study aims to reduce blood glucose by consuming a healthy beverage made of Aloe vera. Numerous studies have investigated the potential effect of Aloe vera on blood glucose reduction in various forms, however, few studies have been published for the treatment of prediabetics by producing standardized Aloe vera juice collaborated with the Aloe Vera Center. Therefore, this study focused on the effect of Aloe vera juice consumed for a 15-day program on reducing fasting blood glucose.

2. RESEARCH METHOD

This pretest-posttest study design was conducted at Alianyang Public Health Center, Pontianak, West Kalimantan. Patients who visited between March and July 2021 were enrolled in this study. A total of 57 patients were screened through fasting blood glucose (FBG) measurement. Those aged ≥25 years old living in Pontianak City and identified with prediabetes (FBG between 100-125 mg/dL) (CDC, 2023) from the screening examination were included. Informed consent was provided by the included subjects. Exclusion criteria were subjects with chronic diseases, such as heart disease, stroke, or kidney disease, and pregnant women who consume blood glucose-lowering drugs. The study was approved by the Health Research Ethics Commission of Diponegoro University (Approval No. 226/EA/KEPK-FKM/2020). The investigators had no influence on possible changes in glucose-lowering medication.

A 15-day program of 1 bottle of Aloe vera juice was developed with the aim of helping subjects reduce their blood glucose by consuming developed juice. Aloe vera was taken from the Agricultural Center located in Siantan, Pontianak City. The standardized manufacturing process was produced in Aloe Vera Center by using the following ingredients: 100 grams of aloe vera gel, 100 ml of water, 2 ml of Kafir lime, and 2 drops of zero-calorie stevia as a natural sweetener for people with prediabetes, 35 kilograms of washed and cleaned fronds of Aloe vera, stripped by filleting to separate the Aloe vera flesh from the outer skin, and washed four times and boiled in a pot with some water for 5–10 minutes at the temperature of 60–70 °C so as not to remove the nutrients. Then it was removed and put into ice water with a temperature of 0–5 °C. Next, it was drained and blended or crushed with a blender. After weighing, the crushed aloe vera gel was boiled again for 5 minutes and mixed with water, stevia, and Kasturi lime to make the aroma fresh. Overall, the composition of the juice consisted of 100 grams of Aloe vera, 2 ml of Kasturi orange, 2 drops of stevia, and 75 ml of water.

In this intervention, subjects with prediabetes are empowered to consume a bottle of 175 ml of Aloe vera juice every day for 15 days consecutively. After 15 days, subjects were invited for a follow-up meeting and measured the fasting blood glucose level using a glucometer with the Accu Check brand, a blood pressure measurement instrument with the Omron brand, an anthropometric measuring instrument to calculate the BMI, and a stadiometer to measure body height and weight. The subjects were asked to do an overnight fast (not eating) for around 8-10 hours before taking the blood.

The analyses presented in this study included patients identified with prediabetes, who completed the 15-day program and completed both baseline and follow-up FBG examinations that were measured by a healthcare professional such as a doctor or nurse practitioner at the location study. The intervention adherence was ensured by asking the subjects. A day prior to the start of the program and 1 week before the final meeting, subjects received a notification to complete the program.

SPSS was used for conducting the statistical analyses. First, descriptive analyses were performed to describe the sociodemographic characteristics of the participants. Data were described as mean ± SD, as they were normally distributed, or percentage. The paired sample t-tests were performed on changes in FBG parameters (follow-up minus baseline). Results were interpreted as statistically significant when $p<0.05$ (two-sided).

3. RESULTS AND DISCUSSION

A total of 12 subjects met the inclusion criteria and started the program and completed both before and after intervention. Of these 12 subjects, 66.7% were aged 26-45 years and female (75.0%). The majority had higher education or university (66.7%) and housewives (25%). Referring to the results of BMI calculations, 50% of the study participants experienced overweight.

Table 1. Demographic Characteristics of Subjects at Baseline

Characteristics	Category	Frequency (N= 12)	Percentage
Age	Adult (26-45)	8	66.7
	Elderly (46-70)	4	33.3
Sex	Male	3	25.0
	Female	9	75.0
Education	Basic education	1	8.3
	High School	3	25.0
	University	8	66.7
Occupation	Entrepreneur	5	41.7
	Retiree	2	16.7
	Housewives	3	25.0
	Civil worker	2	16.7
BMI	Normal 18,5-24,9 kg/m3	4	33.3
	Overweight 25-29,9 kg/m3	6	50.0
	Obesity ≥ 30 kg/m3	2	16.7

This study found a significant mean difference in FBG levels before and after the intervention by consuming Aloe vera juice for 15 days (p-value <0.05). The mean of FBG after intervention was lower than prior among prediabetic patients.

Table 2. The Mean Difference of Fasting Blood Glucose Levels

Intervention Group	Mean	Standard Deviation	Standard Error	p- value
Pre-test	107.42	7.76	2.24	<0.001
Post-test	93.75	9.44	2.73	

The present findings show that a 15-day Aloe vera juice consumption led to a reduction of blood glucose reflected by lower FBG. Additionally, statistical analysis strengthens this result through the significant reduction of blood glucose from 107.42 to 93.75 after the intervention (p<0.001). These results are consistent with the previous study, a reduction of blood glucose after consuming aloe vera juice for 14 days (Pertiwi, & Rahayuningsih et al., 2012), and an average of 22 mg/dL reduction (Istiana, 2019).

The most noticeable implication was the reduction of glucose may lower medication. In this study, the highest reduction of 21 mg/dL, was considered a similar effect compared to previous findings within the 15 days of the program. Numerous studies have demonstrated the effect of Aloe vera on decreasing blood glucose, however, limited sources explain exactly the period for the mechanism of Aloe vera to work effectively in the body. Other similar studies intervened in the subjects for 10 consecutive days (Sari, 2010), 14 days (Pertiwi, & Rahayuningsih et al., 2012), and 4 weeks (Alinejad-Mofrad et al., 2015). Nevertheless, those findings supported the effect of consuming Aloe vera in reducing blood glucose among prediabetes patients (Istiana, 2019; Kabosu, Adu, & Hinga, 2019).

Aloe vera is known as a member of the Liliceae family, a perennial plant with turgid green leaves joined at the stem (Minjares-Fuentes & Femenia, 2019). Aloe vera components, such as minerals and polyphenols are reported to have insulinotropic effects, contributing a direct and indirect major role in insulin secretion (Deora & Venkatraman, 2022; Hamman, 2008). A reduction of fasting and postprandial blood glucose levels after nutrition intervention using Aloe vera was higher as compared to the earlier treatment in which only supplementation was done (Choudhary et al., 2014; Rahoui et al., 2018). The reduction of blood glucose is

affected by chromium, fiber, inositol, and vitamins which function as anti-hypoglycemics and lower blood sugar levels (Kusnanto, Sriyono, & Astuti, 2008). Therefore, Aloe vera has the potential to decrease blood glucose through pancreatic cell protection and improve insulin sensitivity.

An earlier meta-analysis study claimed that Aloe vera significantly lowered fasting blood glucose in the intervention group compared to controls (Budiastutik et al., 2022). Some studies use Aloe vera in capsules, gels, and juice (Soni et al., 2014; Surya et al., 2020). Intervened subjects by giving 300 mg capsules and 100 mg Aloe vera gels have supported positive results (Alinejad-Mofrad et al., 2015; Malinti & Jael, 2019). In India, a 500 mg dose of aloe vera given to rats had a more effective effect compared to 300 mg (Chaudhary et al., 2019). Dose at 100 and 200 grams statistically reduces fasting blood glucose levels among prediabetic patients (Bansal, 2015; Zhang et al., 2016).

However, it is also well-known that the factors for reducing blood sugar are complex and can be caused by other factors, including demographic characteristics and lifestyle (Alhassan et al., 2022). In this current study which involved prediabetic patients, the majority of subjects were adults aged 16-45 years and 75% were women. These proportions supported the current data, as it has been observed that women have more years of disease on average than their male counterparts (Ciarambino et al., 2022; Kirkman et al., 2012). Females tend to be more at risk of developing diabetes mellitus with a large body mass index related to the menstrual cycle and during menopause, resulting in easy accumulation of fat that causes delays in the transport of glucose into cells (Trisnawati, & Setyorogo, 2013). Post-menopause, body fat very easily accumulates as a result of hormonal processes, increasing the risk of prediabetes and diabetes mellitus in women, while married women are at risk for prediabetes 2.7 times (Liberty, 2016). It seems to be related to the fact that sex hormones have a great impact on energy metabolism, body composition, vascular function, and inflammatory responses (Ciarambino et al., 2022).

In addition, age is one of the non-modifiable risk factors for prediabetes and diabetes mellitus, hence, the prevalence of prediabetes will increase due to age (PERKENI, 2019). Increasing age will indirectly reduce the function of several organs that will affect the body's systems, including the function of the pancreas in producing the insulin hormone. Consequently, these are impactful in increasing the risk of prediabetes and diabetes mellitus (Khalid, Samia, & Muneera, 2018). Furthermore, age 20–44 years is associated with prediabetes with a value of $p<0.001$ (Astuti, 2019). Being older means there will be a decrease in body functions, including pancreatic function and pancreatic beta cells, which are unable to produce insulin to control blood sugar levels (CDC, 2020).

Body Mass Index (BMI) cannot be ignored as the contributor factor of higher blood glucose. This study estimated that 50.0% of respondents with prediabetes are categorized as overweight. Biologically, if obesity occurs, it will be a risk factor because the pancreas will work harder to optimize high blood sugar levels due to excessive food by increasing insulin production until the beta cells of the pancreas are unable to produce enough insulin to balance the excessive input of calories, resulting in impaired glucose tolerance, which will eventually cause diabetes mellitus (Lee et al., 2018).

While most previous studies use more or equal to 200 ml juice of Aloe vera to reduce blood glucose (Istiana, 2019), nonetheless, the present study proves a significant reduction reaching 21 mg/dL by consuming 175 ml for 15 consecutive days. Over a 15-day trial, the impact of Aloe vera juice on prediabetics showed a significant decrease in blood glucose. However, it is well-acknowledged that this study's lack of subjects' adherence concerns. The investigators did not consider the scenario of controlling or supervising subjects to regularly consume the juice provided. In addition, not specifying the time at which subjects should drink the juice could influence the possibility of biasing the study results. Other potential factors,

such as physical activity and diet may be confounded these findings. Furthermore, a small sample size may not be representative of the population of interest.

4. CONCLUSION

This evidence strongly suggests that consuming 175 ml of Aloe vera juice for 15 days may be effective in reducing fasting blood glucose (FBG) among 12 adult prediabetics. However, this study is associated with some limitations, such as subjects' adherence monitoring, other potential confounders, and a small sample size. The lack of adherence monitoring is perhaps the most crucial to ensure the effect of the intervention. Therefore, future studies should focus on the subjects' adherence and consider the other confounders to minimize the bias.

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