The Effect of Aloe vera Juice Before Meals on Fasting Blood Sugar (FBS) Level of T2DM Patients

Rif'an Nur Surya[1], Sugiarto[2], Adi Magna Patriadi Nuhriawangsa[3]

[1]Postgraduate Program of Nutrition Science, Sebelas Maret University, Surakarta, Indonesia,
[2]Lecturer, Department of Internal Disease Faculty of Medicine, Sebelas Maret University, Surakarta, Indonesia,
[3]Associate Professor of Animal Science, Department of Animal Sciences Faculty of Agriculture, Sebelas Maret University, Surakarta, Indonesia

Abstract

Diabetes, especially type 2 diabetes mellitus (T2DM), the prevalence continues to increase, with the largest increase occurring in low and middle income countries. The active content of aloe vera functions as antioxidants, flavonoids, regulates body weight and antihyperglycemic, namely acemannan and glucomannan, which are included in the Liliaceae family and are succulent plants, shrubs, xerophytes commonly used to treat wound healing, microbial infections, skin diseases and inflammation. This study aims to analyze the effect of aloe vera juice before meals on fasting blood sugar levels in T2DM patients with an analytical study. Pre-post Test Control Group Design was used in the research design. The subjects were given aloe vera juice before lunch in the treatment group while the control group was given mineral water. Based on the results of statistical tests, there was a significance (p value = 0.022) in the aloe vera juice group and in the control group p value = 0.094. There is an effect of giving aloe vera juice to T2DM patients who are given lunch while there is no effect in the control group who is given mineral water. Further research on the effect of pre-meal aloe vera juice on cholesterol is recommended.

Keywords: *Aloe vera juice, before meals, fasting blood sugar*

Introduction

Metabolic disease due to increased blood sugar levels due to abnormal secretion insulin or insulin action or both is a sign of diabetes mellitus[(1–3)]. Aloe vera leaf gel has therapeutic properties as an antidiabetic, immunomodulator, anti-inflammatory, antioxidant, wound healer, anti-cancer [(4)].

Low and middle income countries are experiencing a significant increase in the prevalense of diabetes and in many developed countries the main cause of end-stage kidney disease is type 2 diabetes. [(5)].

Corresponding author:
Rif'an Nur Surya,
email : aiman_collection@yahoo.co.id

Diabetes mellitus sufferers worldwide are now estimated to be around one in eleven adults with 90% having type 2 diabetes mellitus (T2DM)[(3)]. The interaction of genetic and metabolic factors such as gestational DM, family history of diabetes, is a risk of T2DM which was previously combined by age, obesity, smoking, lack of activity and an unhealthy diet [(6).]

Modification of diet and physical exercise as non-pharmacological therapy to control glycemic levels based on recommendations from several international diabetes organizations [(3,6,7)]. Three basic principles of diet management for DM patients developed by the Indonesian Endocrinology Association (IEA), namely regular meal times, correct consumption of quantities and types[(8)]. However, most diabetic patients only reduce the frequency of eating and intake with a high glycemic index[(9)].

The Diabetes Prevention Program states that prevention of the onset of type 2 DM is more effective with lifestyle changes compared to the use of drugs[10] such as metformin, thiazolidindion and acarbose which can only reduce risk by 31%[11]. Functional food has sensory characteristics in the form of appearance, color, texture and taste that can be accepted by people and does not provide contra indications and side effects on the recommended number of uses for the metabolism of other nutrients[12] with bioactive components that affect the body such as micronutrients, fiber, antioxidants, phytochemicals and prebiotics[13].

Aloe vera species that are often used are aloe vera as a functional food including the Liliaceal family and more than 200 species worldwide with the common name Aloe barbadensis[14] containing active ingredients such as fiber, vitamin, mineral and amino acid that play an important role in curing diseases[15,16]. The active antihyperglycemic ingredients in aloe vera are polysaccharides acemannan and glucomannan, glycoproteins, antioxidants, flavonoids and various vitamins and minerals[17]. Aloe vera extracts show preventive effects on insulin resistance and lipid-reducing effects[18,19] and reduce macro and micro vascular risks such as eliminating nephropathy and diabetic retinopathy, healing diabetes wounds [20–23].

Glucomannan has activity can inhibit the action of HMG Co-A reductase in lipid profile biosynthesis in cells and inhibits the action of Acyl Co-A Cholesterol Acyl Transferase (ACAT) so as to reduce the incidence of dyslipidemia[24] . Aloe vera contains a large amount of antioxidants including flavonoids, alfa tocoferol, carotenoids, ascorbat acid and tannins separating nitric oxide, as seen in vitro studies of radioprotective effectiveness aloe vera gel[25].

Aloe vera can asc as a safe anti hyperglicemic and anti hipercholesterolemic for T2DM in clinical studies patient without significans effect for normal blood lipid kidney function[26]. The water-soluble components of aloe vera can modulate mRNA expression via the glucose-4 transport pathway so that it can lower glucose. [27].

Changes in lifestyle behavior by increasing fiber intake have the potential to reduce diabetes in the community[28] such as consuming fruits, green and yellow leafy vegetables that have high fiber content[29].

Based on the above background, the researchers formulated the problem in this study, namely analyzing the effect of aloe vera juice before meals on fasting blood sugar (FBS) levels in T2DM patients. The results of this study are expected to provide empirical evidence about the allegation that the effect of aloe vera juice before meals on reducing fasting blood sugar levels in T2DM patients and providing input to the public about one effective way to reduce fasting blood sugar levels in patients T2DM.

Methods

Analytical research with a randomized experimental study approach. Pre-post Test Control Group Design was used in the research design [30]. The experimental design of outpatient T2DM patients at Sambas Hospital was given 300 ml aloe vera juice at 30 minutes before lunch for 14 days and the control group was given 300 ml mineral water 30 minutes before lunch. Measurement of fasting blood sugar levels was carried out before and after the study.

The population in this study is outpatients who have T2DM status without severe complications in Sambas Regional Hospital Sambas Regency, West Kalimantan Province with a large sample of 22 people.

The selection of research subjects is simple random sampling[30]. Subjects are taken randomly without ignoring the conditions that have been determined, so that the overall design can be referred to as Purposive Random Sampling, which is a combination of the use of purposive techniques and Simple Random Sampling.

Data analysis was carried out on the effect of giving aloe vera juice to T2DM outpatients by comparing before and after treatment in the experimental group. Differences in average fasting blood sugar levels in each group were tested by different tests (Paired t test).

The hypothesis in this study are "There is an effect of giving aloe vera juice before meals to reduce fasting blood sugar levels in T2DM patients".

Results

Characteristics of respondents are shown in Table 1. There were 11 respondents in each treatment group and control group who met the criteria. The results showed as many as 7 respondents (63.6%) each in the treatment and control group were female. A total of 7 respondents (63.6%) in the treatment group and 8 respondents

(72.7%) in the control group aged 46-55 years, had work as a government employees as many as 5 respondents (45.5%) in the treatment group and as housewives as many as 5 respondents (45.5%) in the control group, have a college education background of 5 respondents (45.5%) in each treatment group and control group and have a BMI with a range between 18.5- 24.9 as many as 8 respondents (72.7%) in each treatment group and control group.

Table 1. Characteristics of Respondents

Characteristics of Respondents	Treatment		Control	
	Frequency	Percent (%)	Frequency	Percent (%)
Gender				
- Male	4	36,4	4	36,4
- Female	7	63,6	7	63,6
Age				
- 20-45 years old	2	18,2	1	9,1
- 46-55 years old	7	63,6	8	72,7
- > 55 years old	2	18,2	2	18,2
Occupation				
- Housewife	4	36,4	5	45,4
- The farmer	1	9,1	1	9,1
- Honorary	1	9,1	-	-
- Government employees	5	45,4	4	36,4
- Entrepreneur	-	-	1	9,1
Education				
- Primary School	3	27,3	3	27,3
- Junior High School	2	18,2	2	18,2
- Senior High School	1	9,1	1	9,1
- University	5	45,4	5	45,4
BMI (Body Mass Index)				
- 18,5-24,9	8	72,7	8	72,7
- 25-29,9	3	27,3	3	27,3

The results of the examination of fasting blood sugar (FBS) of respondents before and after receiving treatment and in the control group can be seen in Table 2.

Table 2. FBS values of the treatment and control groups

FBS	Treatment		Control	
	Before	After	Before	After
N	11	11	11	11
Mean	204,54	168,54	162,27	199,00
Std. Deviasi	80,39	46,45	34,29	70,47
Minimum	107,00	100,00	115,00	100,00
Maksimum	307,00	254,00	221,00	291,00

The average value of inspection of FBS before treatment is 204.54 with the lowest value of 107.0 and the highest of 307.0. While after treatment the average value of FBS of 168.54 with the lowest value of 100.0 and the highest value of 254.0. In the control group the average value of examination of FBS before being given mineral water was 162.27 with the lowest value of 115.0 and the highest of 221.0. While after treatment the average value of FBS is 199.0 with the lowest value of 100.0 and the highest value of 291.0.

The analysis used was the parametric Paired Sample T Test because the variable data in the treatment group and the control group were normally distributed. The results of the analysis are shown in Table 3.

Table 3. Paired Samples Statistics Treatment and Control Groups

	Paired Differences					t	df	Sig. (2-tailed)
	Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference				
				Lower	Upper			
Blood Sugar Before Juice - Blood Sugar After Juice	36,00	44,27	13,35	6,26	65,741	2,70	10	,022
Blood Sugar Before Given Mineral Water - Blood Sugar After Given Mineral Water	-36,73	65,84	19,855	-80,96	7,50	-1,85	10	,094

The significance value of 0.022 is smaller than 0.05, which means that there is a significant change in FBS between before treatment and after treatment in study respondents who received aloe vera juice before meals.

In the control group the significance value of 0.094 is greater than 0.05 which means that there is no significant change in FBS between before treatment and after treatment.

Discussion

Before joining the program, we conducted nutrition counseling to respondents and in general they suffered

from DM and were treated for outpatient treatment. Respondents can prepare their own food according to the dietary recommendations given and some respondents have an incorrect perception of their diet. They limit rice and sugary foods and reduce the frequency of eating, but still consume other sources of carbohydrates during their snack time. This causes their FBS levels not to decline even some have increased after the program, especially in the control group.

According to Imai and Kajiyama[31] that consuming vegetables 7 minutes by chewing 20 times before consuming rice can reduce postprandial blood glucose levels and insulin levels compared to vegetable consumption after rice.

Research conducted by Shukla *et al*[32]states that consumption of protein and vegetables before carbohydrates can reduce postprandial glucose levels by 28.6%, 36.7% and 16.8% at 30, 60 and 120 minutes compared to consumption carbohydrate first.

The this study are same with the research of Dwipajati[33] and Nagoro[34], who stated that consumption of bananas with a low GI before eating can reduce levels of FBS ± 9 mg / dl in T2DM patients and in healthy people with obesity FBS ± 2.5 mg / dl.

Consumption of fruit fiber can reduce 35% of blood glucose levels [35], consuming protein and vegetables first before carbohydrates for 3 days can reduce levels of PPG (Postprandial Glucose) 34.7 mg / dl and increase insulin levels in T2DM patients[32] and can reduce levels of PPG 32.42 mg / dl in T2DM patients with overweight[36].

Conclusion

In this study shows that there is an effect of giving aloe vera juice in T2DM patients given before meals on FBS levels. The interim order of carbohydrate and fiber consumption during meals has a significant impact on FBS levels.

Recommendation

Limitations of this study include small sample sizes and unclear generalizations for foods with different macronutrient compositions and populations including T1DM and prediabetes.

Recommended for further research on the effect of aloe vera juice before meals on cholesterol.

Conflict of Interest: There is no conflict of interest in this study.

Source of Funding: Funding in this study as a whole is accounted for in the researcher independently. There are no other funding sources.

Ethical Clearance: Taken from Health Research Ethics Committee Sebelas Maret University **(No. 020/ UN27.06.6.1/KEPK/EC/2020)**

References

1. American Diabetes Association. Standards of Medical Care in Diabetes 2012. 2012;35.
2. Rudijanto A, Yuwono A, Shahab A, Manaf A, Pramono B, Lindarto D, et al. Konsensus Pengelolaan dan Pencegahan Diabetes Melitus tipe 2 di Indonesia 2015. PB. PERKENI; 2015.
3. IDF. IDF diabetes atlas, Eighth edition [Internet]. 2017. 1-150 p. Available from: www.diabetesatlas.org
4. Hamman JH. Composition and applications of Aloe vera leaf gel. Molecules. 2008;13(8):1599–616.
5. Negese D, Magliano D, Nelson R, Pavkov M. The Global Epidemiology of Diabetes and Kidney Disease. Adv Chronic Kidney Dis. 2018 Mar 1;25:
6. World Health Organization. Global Report on Diabetes. Isbn [Internet]. 2016;978:88. Available from: http://www.who.int/about/licensing/%5Cnhttp://apps.who.int/iris/bitstream/10665/204871/1/9789241565257_eng.pdf
7. ADA. Standard of Medical Care in Diabetes-2017. 2017;40.
8. PERKENI. Konsensus Pengelolaan dan pencegahan diabetes melitus tipe 2 di indonesia 2015. Jakarta; 2015.
9. Pathirannehelage S, Subhashinie A, Ekanayake S, Wanigatunge C. Dietary Habits of Type 2 Diabetes Patients : Variety and Frequency of Food Intake. 2016;2016.
10. NDIC. Diabetes Prevention Program. Natl Inst Diabetes Dig Kidney Dis. 2008;
11. PERKENI. Pengelolaan dan Pencegahan Diabetes Melitus Tipe 2 di Indonesia. 2011;
12. Bintari S, Nugraheni K. Penurunan Kadar Gula Darah akibat Pemberian Extra Virgin Olive Oil. 2012;35.

13. Sunarti, Pratiwi R, Purwestri YA, Tunjung WAS, Darniwa AW, Ridwan A. PEran Makanan Fungsional dalam Penanganan Penyakit Degeneratif dengan Pendekatan Nutrigenomik. 2014;
14. Zhang Y, Liu W, Liu D, Zhao T, Tian H. Efficacy of aloe vera supplementation on prediabetes and early non-treated diabetic patients: A systematic review and meta-analysis of randomized controlled trials. Nutrients. 2016;8.
15. Radha MH, Laxmipriya NP. Evaluation of biological properties and clinical effectiveness of Aloe vera: A systematic review. J Tradit Complement Med. 2015;5(1).
16. Gangwar C, Singh P, Kewat RN, Vikram N. Biochemical Composition and Enzymatic Activity of Aloe vera (Aloe barbadensis L .). 2017;6(11)
17. Steenkamp V, Stewart MJ. Medicinal Applications and Toxicological Activities of Aloe . Products. 2008;45:411–20.
18. Kim K, Kim H, Kwon J, Lee S, Kong H, Im SA, et al. Hypoglycemic and hypolipidemic effects of processed Aloe vera gel in a mouse model of non-insulin-dependent diabetes mellitus. Phytomedicine. 2009;16(9)
19. Yagi A, Hegazy S, Kabbash A, Wahab EA-E. Possible hypoglycemic effect of Aloe vera L. high molecular weight fractions on type 2 diabetic patients. Saudi Pharm J. 2009.
20. Bolkent S, Akev N, Ozsoy N, Sengezer-Inceli M, Okyar A, et al. Effect of Aloe vera (L.) Burm. fil. leaf gel and pulp extracts on kidney in type-II diabetic rat models. Vol. 42, Indian J Exp Biol. 2004.
21. Can A, Akev N, Ozsoy N, Bolkent S, Yanardag R, et al. Effect of Aloe vera Leaf Gel and Pulp Extracts on the Liver in Type-II Diabetic Rat Models. Biol Pharm Bull. 2004;27(5).
22. Inpanya P, Faikrua A, Ounaroon A, Sittichokechaiwut A, Viyoch J. Effects of the blended fibroin/aloe gel film on wound healing in streptozotocin-induced diabetic rats. Biomed Mater. 2012;7(3).
23. Zarrintan A, Mobasseri M, Ostadrahimi A. Effects of Aloe Vera Supplements on Blood Glucose Level and Lipid Profile Markers in Type 2 Diabetic Patients – a Randomized Clinical Trial. Pharm Sci. 2015;21(2)
24. Kruger MJ, Davies N, Myburgh KH, Pandey KB, Rizvi SI, et al. Antioxidant effects of plant phenolic compounds. In Basu TK, Temple NJ, Garg ML (eds):"Antioxidants in Human Health and Diseases,." Am J Clin Nutr. 2016
25. Saini DK, Saini MR. Evaluation of radioprotective efficacy and possible mechanism of action of Aloe gel. Environ Toxicol Pharmacol. 2011;31(3).
26. Huseini HF, Kianbakht S, Hajiaghaee R, Dabaghian FH. Anti-hyperglycemi and anti-hypercholesterolemi effects of Aloe vera leaf gel in hyperlipidemic type 2 diabetic patients: a randomized double-blind placebo-controlled clinical trial. Planta Med. 2012;78(4)
27. Kumar R, Sharma B, Tomar NR, Roy P, Gupta AK. In vivo evalution of hypoglycemic activity of Aloe spp. and identification of its mode of Action on GLUT-4 gene expression in vitro. Appl Biochem Biotechnol. 2011;164(8):
28. Feldman EL, Bennett DLH, Nave K, Jensen TS, Arbor A, Pain D. New Horizons in Diabetic Neuropathy: Mechanisms, Bioenergetics, and Pain. 2017;93(6):1296–313.
29. Wang P, Fang J, Gao Z, Zhang C, Xie S. Higher intake of fruits , vegetables or their fi ber reduces the risk of type 2 diabetes : A meta-analysis. 2016;7(1):16–28.
30. Murti B. Desain dan Ukuran Sampel untuk Penelitian Kuantitatif dan Kualitatif dibidang Kesehatan. UGM Press; 2013.
31. Imai S, Kajiyama S. Eating Order Diet Reduced the Postprandial Glucose and Glycated Hemoglobin Levels in Japanese Patients with Type 2 Diabetes. J Rehabil Heal Sci. 2010;8:1–7.
32. Shukla AP, Andono J, Touhamy SH, Casper A, Iliescu RG, Mauer E, et al. Carbohydrate-last meal pattern lowers postprandial glucose and insulin excursions in type 2 diabetes. 2017;6–10.
33. Dwipajati. Pengaruh Konsumsi Buah Sebelum Makan dan Latihan Fisik Terhadap Kadar Glukosa dan Aktivitas Enzim Dipeptidase-4 Pasien Diabetes Melitus Tipe 2. Universitas Sebelas Maret, Surakarta; 2018.
34. Nagoro D. Pengaruh Konsumsi Buah dan Sayur Sebelum Makan Karbohidrat Terhadap Kadar Glukosa Darah, Lingkar Pinggang dan Rasa Kenyang Pada Guru Sekolah Dasar. Universitas Sebelas Maret, Surakarta; 2018.

35. Yuan JYF, Smeele RJM, Harington KD, Van Loon FM, Wanders AJ. The effects of functional fiber on postprandial glycemia, energy intake, satiety, palatability and gastrointestinal well being: A randomized crossover trial. Nutr J. 2014;13.

36. Rochmah D. Pengaruh Urutan Konsumsi Sayuran dan Karbohidrat Terhadap Kadar Glukosa Darah dan Hormon Glucagon Like Peptide-1 Pasien Diabetes Melitus Tipe 2 dengan Overweight. Universitas Sebelas Maret, Surakarta; 2016.