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Effect of Sap Palm (*Borassus flabellifer*) on Blood Glucose Level in Pre-Diabetic Patients

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ABSTRACT

Introduction: Herbal medicines are good alternative treatment for management of blood glucose level. One of the herbal medicines that have potential as anti-diabetic is palm juice (*Borassus flabellifer*).

Objective: This study was aimed to determine the effect of sap palm (*Borassus flabellifer*) on the decrease of blood glucose levels in patients with pre-diabetic.

Methods: Design of quasi-experimental with a randomized pre-test post-test control group design. The total sample was 50 people, divided into two groups: the sap palm intervention group and education of 25 people and the control group with the education of 25 people.

Result: There was a decrease in blood glucose levels in the group that received sap palm interventions, and a significant difference between the groups that received sap palm interventions with the control group. Based on the results of the follow-up, there was a decrease in blood glucose levels every week between the intervention group and the control group. However, the reduction was greater in the group with sap palm intervention. Provision of sap palm for three weeks at a dose of 200 ml 2 times a day, such as a morning and evening after eating, proved effective in reducing blood glucose levels in patients with pre-diabetic.

Conclusions: Sap palm can be used as an alternative herbal medicine for pharmacological therapy in pre-diabetic.

Key Words: Sap palm, Pre-diabetic, Education, Blood glucose

INTRODUCTION

The prevalence of pre-diabetic in Indonesia continues to increase, reaching 10.2%, and Diabetes Mellitus (DM) ranks second cause of death at 14.7%. The proportion of the Indonesian population aged ≥ 15 years with pre-diabetic is 6.9%. South Sulawesi Province ranks third greatest problem of impaired glucose tolerance, after Central Sulawesi 3.4%, North Sulawesi 3.6%.¹

Handling of pre-diabetic and Diabetes Mellitus can be done non-pharmacologically by diet and exercise, as well as pharmacologically by the use of oral diabetes medications and insulin. Long-term use of oral anti-diabetic drugs can cause side effects such as nausea, vomiting, diarrhoea, headaches, ataxia, vertigo, leukopenia, and hypoglycemia. Therefore, the use of herbal medicines is often an alternative treatment. One of the herbal medicines that have potential as anti-diabetic is palm juice (*Borassus flabellifer*).

Sap palm is a liquid from cutting the palm flowers (*Borassus flabellifer*).² In Indonesia, the palm is found in East Nusa Tenggara, East Java, and South Sulawesi. This drink has a sweet taste, and nutritional content (chemical) is quite high with vitamin A, calcium, protein, iron and magnesium.³ The results showed that methanol extract from male flowers of *Borassus flabellifer* could inhibit the increase in serum glucose levels in diabetic rats at a dose of 250 mg/kg. The main steroid saponin, which is *dioscin*, inhibits the rise in serum glucose levels in 50 mg/kg rats.⁴ Research in India found that extracts from sap palm (*Borassus flabellifer*) contain tannin, carbohydrate, terpene, saponin, flavonoid, and alkaloid. There was a decrease in blood glucose in diabetic rats induced by streptozotocin compared with diabetic control rats. These results indicate that the sap palm (*Borassus flabellifer*) has hypoglycaemic and anti-hyperlipidemia effects.⁵

Research on the effects of sap palm (*Borassus flabellifer*) in humans is still very limited, but the tendency of people

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in the village to use herbal medicines is very high compared to medical drugs. Society believes that sap palm can reduce blood glucose. Identity flora in South Sulawesi is in the form of palm trees, one of which is found in the Sidenreng Rappang regency. Panca Lautang district is a place of research because it is a producer of sap palm and has the habit of consuming sap palm and therefore is very potential for research. As a result, this study was conducted to determine the effect of sap palm (*Borassus flabellifer*) on the decrease of blood glucose levels in patients with pre-diabetic.

MATERIALS AND METHODS

This type of research is a quasi-experiment with a randomized pre-test post-test control group design. The study population was the people of Panca Lautang district, Sidenreng Rappang regency, who had pre-diabetic. Samples were obtained through screening, to get new cases of pre-diabetic patients. The screening was conducted by checking blood glucose 140 mg/dl with symptoms of polyuria, polydipsia, and polyphagia, then measuring fasting blood glucose ≥ 100 mg/dl, where respondents fast for 8-12 hours.

The sampling technique used was purposive sampling, with inclusion criteria with respondents aged 30-60 years and did not get medical treatment or other alternatives. Exclusion criteria were patients with complications of kidney, heart, liver, having systolic blood pressure >200 mmHg or diastole >150 mmHg, and having a history of asthma. The sample in this study was divided into two groups, namely group I (the intervention group) with a combined intervention of sap palm and education, while group II (the control group) with an educational intervention. The total sample in this study was 50 respondents, with each group as many as 25 respondents. The statistical analysis used was the dependent t-test and the independent t-test.

The material used in the study for the intervention group was sap palm (*Borassus flabellifer*) by phytochemical testing in the Pharmacy Laboratory of Hasanuddin University. In this study, the dose used was 200 ml or the equivalent of one glass with the rule of drinking two times a day, such as one glass in the morning and one glass in the afternoon. The consumption time of the sap palm is after eating. The sap given is still fresh and has not undergone fermentation.

For examination of fasting blood glucose obtained using a glucometer with the brand of Autocheck. Blood pressure checks using the Onemed brand sphygmomanometer. General characteristics of the sample were obtained through a questionnaire that had previously been tested by conducting a validity and reliability test. The questionnaire contained information about the results of the follow-up of blood glucose measurements every week.

Besides, to control the variables that can influence the effects of the intervention, interviews were also conducted related to physical activity, eating patterns through food recall and food frequency.

RESULT

Subject characteristics in the study were based on gender, age, occupation, education, and genetic history. Most age groups, namely age 36-41 years each as many as 13 people (52.0%) in the intervention and control groups. In the aspect of work, most research subjects were housewives in both the intervention and control groups, which was 56.0%. The highest level of education in the intervention group and the control group was elementary school, 48.0%, and 40.0%, respectively, while the Graduate was only in the control group of 4.0%. The majority of the intervention and control groups did not have a family history of DM, respectively, 68.0% and 76.0% (Table 1).

Table 1: Characteristics of the respondent

Respondent Characteristic	Intervention n = 25 n (%)	Control n = 25 n (%)
<i>Gender</i>		
Male	3 (12.0)	3 (12.0)
Female	22 (88.0)	22 (88.0)
<i>Age (years)</i>		
30 - 35	0 (0.0)	6 (24.0)
36 - 41	13 (52.0)	13 (52.0)
42 - 47	9 (36.0)	6 (24.0)
48 - 53	3 (12.0)	0 (0.0)
<i>Occupation</i>		
Housewives	14 (56.0)	14 (56.0)
Unemployed	2 (8.0)	4 (16.0)
Seller	3 (12.0)	4 (16.0)
Civil Servant	1 (4.0)	0 (0.0)
Entrepreneur	1 (4.0)	1 (4.0)
Farmer	4 (56.0)	2 (8.0)
<i>Education</i>		
Ungraduated Primary	8 (32.0)	3 (12.0)
Primary School	12 (48.0)	10 (40.0)
Middle School	2 (8.0)	10 (40.0)
High School	3 (12.0)	1 (4.0)
Graduate	0 (0.0)	1 (4.0)
<i>Family History of DM</i>		
Exist	8 (32.0)	6 (24.0)
Non-Exist	17 (68.0)	19 (76.0)

Table 2: The difference in blood glucose before and after in intervention group and control.

Group	Blood Glucose						Test Result			
	n	Before Mean	SD	n	After Mean	SD	The difference in Mean	t	p-value*	p-value**
Intervention	25	120.56	4.54	25	86.24	11.95	34.32	13.13	0.05	0.05
Control	25	109.36	10.52	25	104.00	13.45	5.36	1.97	0.06	

*Dependent t-test ; **independent t-test

Table 2 shows that the average difference in blood glucose before and after the intervention was 34.32 mg/dl. The statistical test results obtained p-value = 0.05; this shows that there is a significant difference between blood glucose levels before and after in the sap palm and education intervention group. However, in the control group, the statistical test results obtained p-value=0.06; this indicates that there were no differences in blood glucose levels before and after in the control group. If a comparison is made between the measurement results of blood glucose levels in the intervention group and the control group, the results of the independent t-test obtained a p-value=0.05, which means there is a significant difference between blood glucose levels in the intervention group (sap palm and education) and the control group (education).

Replication is done through measurements of blood glucose levels every week in the intervention group and the control group. It aims to improve internal research validation and to see changes in blood glucose levels in respondents. The results of the analysis showed that in the sap palm intervention group, there was a decrease in blood glucose levels of respondents with an average of between 13.96 mg/dl to 34.32 mg/dl (p-value=0.05). However, in the control group, the average decrease in blood glucose levels of the respondents ranged only from 0.16 mg/dl to 5.36 mg/dl (p-value >0.05) (Figure 1).

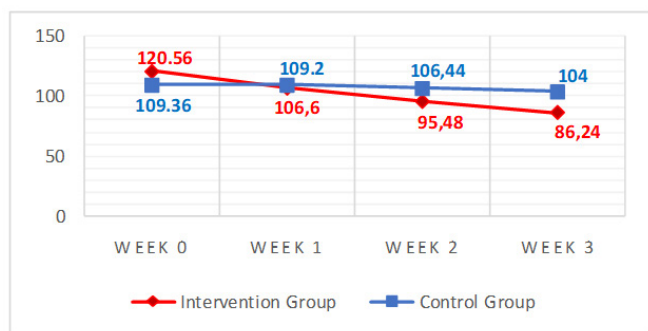


Figure 1: The decrease of blood glucose before and after in intervention group and control group each week.

To control the variables that can affect changes in respondent's blood glucose levels apart from the interventions pro-

vided, this study conducted interviews related to the respondents' diet and physical activity. The results of the analysis showed that the study respondents had an unhealthy eating pattern. This can be seen from the majority of respondents having a habit of eating >3 times a day, namely 33 people (66%), consuming 43 fried foods (86%), not eating fruit as many as 39 people (78%), and excessive sugar consumption that is > 2 tablespoons of each drink a glass of tea or coffee as many as 27 people (54.0%). In terms of physical activity, it is seen that the majority in the intervention and control groups did not carry out physical activity or routine exercise for 150 minutes per week, i.e., 96.0% and 92.0%, respectively. The majority of respondents only did the light physical activity (minimum 30 minutes per week) in the intervention group (52.0%) and the control group (80.0%) (Table 3).

Table 3: Respondent distribution based on eating pattern/habit and physical activity

Variable	Intervention n=25 n(%)	Control n=25 n(%)	Total n=50 n(%)
<i>Eat >1 Plate</i>			
Yes	14 (56.0)	10 (40.0)	24 (48.0)
No	11 (44.0)	15 (60.0)	26 (52.0)
<i>Eat >3x a Day</i>	16 (64.0)	17 (68.0)	33 (66.0)
Yes	9 (36.0)	8 (32.0)	17 (34.0)
No			
<i>Eat Fried Food</i>			
Yes	18 (72.0)	25 (100.0)	43 (86.0)
No	7 (28.0)	0 (0.0)	7 (14.0)
<i>Eat Vegetables</i>			
Yes	24 (96.0)	25 (100.0)	49 (98.0)
No	1 (4.0)	0 (0.0)	1 (2.0)
<i>Eat Fruit</i>			
Yes	11 (44.0)	0 (0.0)	11 (22.0)
No	14 (56.0)	25 (100.0)	39 (78.0)
<i>Sugar Consumption</i>			
≤2 spoons	15 (60.0)	8 (32.0)	23 (46.0)
>2 spoons	10 (40.0)	17 (68.0)	27 (54.0)
<i>Salty Food</i>			
Yes	13 (52.0)	4 (16.0)	17 (34.0)
No	12 (48.0)	21 (84.0)	33 (66.0)

Table 3: (Continued)

Variable	Intervention	Control	Total
	n=25	n=25	n=50
	n(%)	n(%)	n(%)
<i>Physical Activity</i>			
<i>150 minutes per week</i>			
Yes	1(4.0)	2(8.0)	3 (6.0)
No	24 (96.0)	23 (92.0)	47 (94.0)
<i>30 minutes per day</i>			
Yes	13 (52.0)	20 (80.0)	33 (66.0)
No	12 (48.0)	5 (20.0)	17 (34.0)

DISCUSSION

The results showed that there were differences in blood glucose levels in the group that received sap palm interventions and education compared to the control group (only received education). Yoshikawa (2007) conducted in Japan states that the methanol extract of male flower *Borassus flabellifer* contains the main steroid saponins, namely Borassoside and dioscin which can inhibit the increase in serum glucose levels in rats that have been given sucrose at a dose of 250 mg/kg, po.⁴ A similar study was conducted by Goyal (2013) in India, based on phytochemical tests found that extracts from palm flowers (*Borassus flabellifer*) contain tannin, carbohydrate, terpene, saponin, flavonoid, and alkaloid. The results of his study stated that there was a significant decrease in blood glucose levels in streptozotocin-induced diabetic rats compared with diabetic control rats.⁵

Based on the results of laboratory tests that have been carried out at the Pharmacy Laboratory of Hasanuddin University show that in addition to containing vitamin C, sap palm is also identified to contain flavonoid compounds and saponins. Vitamin C or ascorbic acid as a non-enzymatic antioxidant plays an important role in protecting cell damage caused by free radicals. Previous studies reported a decrease in vitamin C levels in type 2 DM. Vitamin C can reduce glucose toxicity which contributes to preventing a decrease in pancreatic cell mass and insulin levels.⁶

Flavonoids are natural antioxidants that can ward off free radicals and a role in pancreatic tissue damage caused by DNA alkylation due to the induction of alloxan, as a result, can improve the morphology of rats pancreas. Flavonoids have an anti-diabetic activity that can regenerate cells on the island of Langerhans.⁷ Decreased blood glucose levels occur because of the repair of pancreatic tissue, to increase insulin secretion. As a result, glucose in the blood can be absorbed into cells and can be converted into energy or stored in the form of glycogen in the liver and muscles. This is coherent with the analysis of the correlation between blood glucose levels with insulin, which has a significant negative correlation, such as an increase in plasma insulin levels can reduce

blood glucose levels.

Saponins are known to have hypoglycaemic effects. Hypoglycaemic effects are shown by increasing glucose uptake by cells, increasing insulin release, and increasing the effect of insulin (*insulin sensitizer*).^{8,9} Besides, saponins can stimulate insulin signals in diabetics and increase glycogen accumulation increasing insulin signals and improve glucose homeostasis.¹⁰

Pre-diabetic is generally an asymptomatic condition and predates diabetes. The pre-diabetic condition can be improved through pharmacological and non-pharmacological treatment through lifestyle changes, weight loss, regulating diet, and doing regular exercise. In this study, in addition to pharmacological interventions using herbal medicines in the form of sap palm interventions, the intervention was also carried out in the form of education to increase public knowledge related to pre-diabetic management.

CONCLUSION

The effect of sap palm for 21 days (3 weeks) with a dose of 200 ml or the equivalent of 1 glass taken in the morning and evening after eating, it can be concluded that there are differences in blood glucose levels before and after the intervention group sap palm, and there are differences in blood glucose levels between the intervention group and the control group.

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