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Effect of green tea consumption among patients with type 2 diabetes mellitus at the community health center

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Abstract

Background: Elevated blood glucose levels are a primary symptom observed in patients with diabetes mellitus (DM). Patients with DM employ various strategies to lower their blood sugar levels. One such strategy is the consumption of green tea. Green tea contains various scientifically proven compounds to reduce blood sugar levels, such as Epigallocatechin Gallate (EGCG), caffeine, riboflavin, catechins, and theaflavins,

Purpose: To investigate the reduction in blood sugar levels in patients with DM before and after consuming green tea and to determine whether green tea intake has an impact on patients' blood sugar levels.

Method: This study utilized a quasi-experimental one-group pre-post design. The population of this study comprised 115 DM patients in Panyileukan Community Health Center, selected using purposive sampling techniques based on the inclusion criteria of active participation in the Diabetes Mellitus Control Program and absence of complicating diseases. Ultimately, 33 patients committed to participating in the study.

Results: The average blood glucose level before the intervention was 193.52 mg/dl, which decreased to 151.03 mg/dl after the intervention. This indicates that the consumption of green tea has a significant effect on reducing blood sugar levels. The reduction in blood sugar levels varied among participants, depending on individual body responses and the consumption of other unmonitored foods during the study.

Conclusion: The flavonoid content, along with caffeine and riboflavin, in green tea has a significant impact on reducing blood sugar levels in patients with DM.

Keywords: Blood Sugar Level; Diabetes Mellitus; Green Tea.

INTRODUCTION

Diabetes mellitus (DM) is a disease associated with an unhealthy lifestyle. Data from the International Diabetes Federation (IDF) indicates that 537 million adults aged 20-79 years are suffering from Diabetes. Indonesia, with a population of 179.72 million, has 19.47 million people with diabetes, meaning the prevalence of Diabetes reaches 10.6%. By 2045, the IDF projects a 46% increase. This means that 1 in 8 adults, or around 783 million people, will live with diabetes (International Diabetes Federation, 2021). Diabetes is one of the four priority non-communicable diseases that are the leading causes of blindness,

heart attacks, strokes, kidney failure, and leg amputations (Ministry of Health of the Republic of Indonesia, 2015). Risk factors leading to DM include unhealthy eating patterns, lack of activity, stress, obesity, and age factors (Boku, Ruhyana, & Suprayitno, 2019). High-carbohydrate, sugar, soda, and fast food consumption should be avoided in favor of a healthier diet (Purnomo, 2023). Healthy lifestyle habits that support improvement in those with DM include managing eating patterns, both in terms of food types and quantities. Foods and drinks recommended for people with DM should meet low-carbohydrate and low-glucose criteria. In addition to

dietary management, controlling blood sugar levels, medication, exercise, and reducing stress are the management strategies that should be undertaken for DM (Global Initiative For Asthma, 2023). Consuming salty foods poses a risk for DM as sodium is the largest component in salty foods, leading to fluid retention and causing hypertension, which is one of the risk factors for diabetes mellitus (Susilowati, & Waskita, 2019). Socio-economic status has a significant relationship with the prevalence of diabetes mellitus in people over 15 years of age in Indonesia (Indrahadi, Wardana, & Pierewan, 2021). Degenerative diseases are caused by the body's inability to neutralize the increased concentration of free radicals due to the lack of available antioxidants, thus external antioxidants are needed to counteract the free radicals causing cell damage. Diabetes, a heterogeneous disorder which is primarily characterized by impaired hormone secretion, is also caused by several impairments like protein, fat, and carbohydrate metabolism by either insufficient amount of insulin production or reduced sensitivity of tissue to insulin (Pistrosch, Ganz, Bornstein, Birkenfeld, Henkel, & Hanefeld, 2015).

Generally, treatment to lower blood glucose levels can be done in two ways: using chemical drugs or herbal medicines combined with chemical drugs. Some herbal medicines that can reduce blood glucose levels include consuming fruits, vegetables, and traditional drinks like tea (Efendi, Damayanthi, Kustiyah, & Kusumorini, 2010). There are several types of plants known for their medicinal properties, such as the nipa palm (*Nypa fruticans*) used for asthma, diabetes, leprosy, rheumatism, and snakebites (Bintoro, 2014). Starfruit leaves contain flavonoids, saponins, tannins, sulfur, formic acid, peroxidase, calcium oxalate, and potassium citrate. Flavonoids have several pharmacological activities that act as antioxidants and antidiabetics. This makes starfruit leaf tisane suitable as a complementary therapy to control blood sugar levels in type 2 diabetes mellitus patients (Sutomo, & Purwanto, 2023). Insulin plant leaves are used as a diabetes medication and wound treatment (Tambaru, 2017).

Tea is a traditional drink, a heritage from the ancestors of the Indonesian nation, with many benefits. The Epigallocatechin content in tea can lower blood sugar levels. Tea, a product of the leaves and buds of *Camellia sinensis* (*Theaceae*) plant, is consumed worldwide. Tea can broadly be classified based on the production method as unfermented (green tea), half-fermented (oolong tea), fully fermented (black tea), or post fermented (pu-erh tea) (Miyoshi, Pervin, Suzuki, Unno, Isemura, & Nakamura, 2015). EGCG in tea can stimulate the absorption of glucose into skeletal muscle cells, thereby reducing blood sugar levels (Holidah, & Christianty, 2015).

RESEARCH METHOD

This study is a quasi-experiment. The population of this study consisted of 115 DM patients in the service coverage area of Panyileukan Community Health Center. The study employed purposive sampling with inclusion and exclusion criteria, resulting in 33 participants willing to provide informed consent.

Subsequently, the researcher created a WhatsApp group as a communication medium for monitoring. The sample size was calculated using the Slovin formula with a confidence level of 10%. The independent variable was the provision of green tea, and the dependent variable was blood sugar levels. To obtain pre-test data, the researcher measured blood sugar levels before administering the treatment to all participants.

After a two-week intervention, the researcher measured the participants' blood sugar levels as post-test data. The intervention involved regular consumption of one cup of green tea in the morning and evening every day for two weeks. The tools and materials used in the study included a blood sugar testing kit consisting of an Easy Touch glucometer, lancet, sterile needles, and alcohol swabs.

The researcher provided a checklist during the activities and informed the participants of the blood sugar test results. The amount and type of tea given to the participants were the same, in sachet form (tea bags), to avoid errors in the composition and concentration of the consumed tea.

Data analysis was performed using SPSS to examine the effect of the treatment intervention on blood sugar levels in the participants. If the research data were normally distributed, data analysis was conducted using the Paired T-Test, and if the data were not normally distributed, data analysis was performed using the Wilcoxon Test.

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This study has obtained permission and recommendation from the Health Research Ethics Committee of Bhakti Kencana University Bandung with letter No. 149/09.KEPK/UBK/IX/2023, dated September 4, 2023.

RESEARCH RESULTS

Table 1. Characteristics of Participants (N=33)

Variables	Value
Age (n/%)	
(Mean±SD)(Range)(Year)	(70.18±5.394)(63-82)
63 – 70 years old	21/63.6
71 – 82 years old	12/36.4
Gender (n/%)	
Male	15/45.5
Female	18/54.5

Table 1 shows that the age of the participants ranged from 63 to 82 years, with a mean of 70.18 and a standard deviation of 5.394. Meanwhile, for participants aged 63-70 years, it was 63.6%, and for those aged 71-82 years, it was 36.4%. As for the gender of the participants, males accounted for 45.5%, while females accounted for 54.5%.

Table 2. Blood Sugar Levels (N=33)

Variables	Pre-Test		Post-Test		p-value
	Mean	**SD**	**Mean**	**SD**	
Age					
63 – 70 years old	191.0	77.4	149.9	59.2	0.000
71 – 82 years old	197.8	72.1	152.9	58.3	
Gender					
Male	189.6	73.8	152.0	57.9	0.000
Female	196.7	76.9	150.1	59.7	

Table 2 shows the results of the statistical test for blood sugar levels. For the age factor, the p-value is 0.000. The pre-test blood sugar level data for participants aged 63-70 years had a mean of 191.0 with a standard deviation of 77.4, while the post-test data had a mean of 149.9 with a standard deviation of 59.2. For participants aged 71-82 years, the pre-test blood sugar level data had a mean of 197.8 with a standard deviation of 72.1, and the post-test data had a mean of 152.9 with a standard deviation of 58.3.

Furthermore, for the gender factor, the p-value is 0.000. The pre-test hyperglycemia content data for males had a mean of 189.6 with a standard deviation of 73.8, while the post-test data had a mean of 152.0 with a standard deviation of 57.9. For females, the pre-test blood sugar level data had a mean of 196.7 with a standard deviation of 76.9, and the post-test data had a mean of 150.1 with a standard deviation of 59.7.

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DISCUSSION

Based on the results of blood sugar level examinations of DM patients who routinely participate in the Prolanis program at Panyileukan Community Health Center, it was found that the highest blood sugar level before treatment was 339 mg/dl, and the lowest was 97 mg/dl. After receiving treatment by regularly consuming green tea in the morning and evening, one cup each day for two weeks, the highest blood sugar level post-treatment was 298 mg/dl, and the lowest was 68 mg/dl. The examination results showed that the average blood sugar level before treatment of 193.52 mg/dl decreased to 151.03 mg/dl. This indicates that green tea consumption has a significant effect on reducing blood sugar levels. Polyphenols, as antioxidants, reduce free radicals, inhibit cholesterol oxidation, and lower blood glucose (Meiwati, Novitasari, & Maryoto, 2021).

DM is a condition characterized by elevated blood sugar levels due to insufficient insulin secretion, impaired insulin function/insulin resistance, or both processes. This can result in damage, failure, and dysfunction of vital organs such as the eyes, kidneys, nerves, heart, and blood vessels (Pahlevi & Mutia, 2021; American Diabetic Association, 2020). Hyperglycemia in DM patients can be caused by gluconeogenesis, glycogenolysis, and lipolysis as efforts to maintain adequate glucose levels within cells (Kumar, & Gill, 2018). Drinking green tea is an ancestral tradition with many health benefits, one of which is to lower blood sugar levels in DM patients.

Increased blood glucose levels are caused by three main factors: pancreatic disorders, which can be due to decreased sensitivity to blood glucose/abnormal insulin secretion; increased glucose production by the liver due to increased gluconeogenesis; and the stimulation of glucagon and catecholamines, along with insulin resistance in peripheral tissues, resulting in disrupted glucose transport and metabolism. Another compound found in green tea is flavonoids. Flavonoids, as antioxidants, inhibit lipid oxidation. They also inhibit or block the activity of key enzymes in lipogenesis, namely HMG-CoA reductase. Inhibition of this enzyme halts cholesterol synthesis, reducing cholesterol levels (Meiwati, Novitasari, & Maryoto, 2021).

In vitro studies indicate that catechins and theaflavins in tea can prevent hyperglycemia by increasing insulin activity and possibly by preventing damage to pancreatic β-cell due to tea compounds also having antioxidant properties that can prevent oxidative ROS reactions in the pancreas. Looking at the mechanism of action of tea in lowering blood glucose levels, tea works on two diabetes therapy targets: in the pancreas and in the glucose target organ, namely muscle. EGCG in tea can stimulate glucose absorption into skeletal muscle cells, thereby reducing blood sugar levels (Holidah, & Christianty, 2015). EGCG, the most abundant form of catechin in green tea, has been known to be the main attributable factor of beneficial effects of green tea (Higdon, & Frei, 2003). On the other hand, green tea is a widely used drink which has several protective functions. This plant possesses multiple cathecin, theoflavins, flavonoids, flavinol, caffeine, and other biological active components (Mohib, Rabby, Paran, Hasan, Ahmed, Hasan, & Mohiuddin, 2016).

CONCLUSION

The flavonoids, caffeine, and riboflavin in green tea has a significant effect on reducing blood sugar levels in diabetic patients.

SUGGESTION

Giving green tea to diabetic patients will greatly assist in managing blood sugar levels, thereby stabilizing body metabolism to become healthier. Making a habit of drinking green tea can also be part of a health therapy regimen during treatment.

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