

RED BEAN COOKIES (*IPOMOEA BATATAS L*) CAN REDUCE FASTING BLOOD GLUCOSE LEVELS IN TYPE II DIABETES MELLITUS PATIENTS

*Cookies Kacang Merah (Ipomoea Batatas L) Dapat Menurunkan Kadar Glukosa
Darah Puasa pada Penderita Diabetes Mellitus Tipe II*

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ABSTRAK

Tingginya prevalensi diabetes melitus berkaitan dengan perubahan gaya hidup yang dipengaruhi oleh faktor sosial dan urbanisasi. Kebiasaan seperti konsumsi makanan cepat saji dan manajemen diet yang buruk, merupakan beberapa faktor penyebabnya. Ketidakmampuan menjaga kadar glukosa darah tetap dalam batas normal disebabkan oleh kurangnya disiplin dalam menjalani diet atau ketidakmampuan mengurangi asupan kalori dari makanan. Cookies kacang merah dengan takaran 50 gram diberikan selama 21 hari digunakan sebagai alternatif snack bagi penderita diabetes mellitus karena kacang merah memiliki indeks glikemik yang rendah serta kandungan antosianin dan serat yang tinggi. Penelitian ini dilakukan untuk mengetahui pengaruh pemberian kacang merah terhadap kadar gula darah pada pasien diabetes melitus tipe 2. Penelitian ini menggunakan desain penelitian pre-experimental dengan rancangan One Group Pretest Posttest. Teknik pengambilan sampel yang digunakan adalah non-probability sampling dengan metode purposive sampling, melibatkan 30 responden. Uji statistik dilakukan dengan menggunakan Wilcoxon dan Mann-Whitney. Penelitian ini dilaksanakan selama 21 hari, dari tanggal 23 September hingga 14 Oktober 2024, di wilayah Puskesmas Sukamakmur, Aceh Besar. Hasil rata-rata kadar glukosa darah puasa pretest adalah 226.40 mg/dL dan posttest menjadi 186.60 mg/dL ($p < 0.001$). Penelitian ini menunjukkan adanya perbedaan yang signifikan antara perlakuan sebelum dan sesudah pemberian cookies kacang merah 50 gram sehari selama 21 hari. Hasil statistik menunjukkan bahwa cookies kacang merah dapat menurunkan kadar glukosa darah namun belum mencapai angka kadar glukosa darah puasa dalam batas normal.

Kata kunci: diabetes tipe II, glukosa darah, kacang merah

ABSTRACT

The high prevalence of diabetes mellitus is related to lifestyle changes influenced by social factors and urbanization. Habits such as fast food consumption and poor dietary management are some of the contributing factors. Lack of maintaining blood glucose levels within normal limits is caused by a lack of discipline in following a diet or an inability to reduce the number of calories in food. Red bean cookies with a dose of 50 grams given for 21 days are used as an alternative snack for people with diabetes mellitus because they have a low glycemic index and are rich in anthocyanins and fiber. This study used a pre-experimental research design with a one-group pretest-posttest design. The sampling technique used was non-probability sampling with a purposive sampling method, involving 30 respondents. Statistical tests were carried out using Wilcoxon and Mann-Whitney. This study was conducted for 21 days, from September 23 to October 14, 2024, in the Sukamakmur Health Center area, Aceh Besar. The average fasting blood glucose level pretest was 226.40 mg/dL, and posttest became 186.60 mg/dL ($p < 0.001$). This study showed a significant difference between the treatment before and after giving 50 grams of red bean cookies a day for 21 days. The statistical results

showed that red bean cookies can lower blood glucose levels, but have not reached fasting blood glucose levels within normal limits.

Keywords: blood glucose, red beans, type II diabetes

INTRODUCTION

The International Diabetes Federation (IDF) 2021, stated that the prevalence of DM in adults aged 20 to 79 years has more than tripled, in 2019 the number of DM reached 151 million (4.6%), predicted to continue to increase to 643 million (11.3%) people in 2030, in 2045 to 738 million (12.2%) and 1.5 million deaths are directly linked to DM every year[1]. The prevalence of DM based on the 2018 Basic Health Research (Riskesdas), based on the measurement results of the population aged ≥ 15 years, DM in Indonesia reached 6.9% in 2018, showing an increase in the prevalence of DM to 10.9% and the prevalence of DM in the 2023 Indonesian Health Survey (SKI) increased to 11.7%[2][3]. Aceh Province ranks 7th in terms of the number of patients suffering from DM in Indonesia.[2]In 2022, there were approximately 189,464 cases of diabetes mellitus sufferers in Aceh province, of which 108,684 cases, or 57.36%, received standardized services[4]. Poor dietary management in patients with diabetes mellitus (DM) is a problem that makes blood sugar levels difficult to control. Effective dietary behavior management can help stabilize blood glucose levels in those with DM[5]. Management of high blood glucose levels in diabetes patients involves two approaches: pharmacological and non-pharmacological. Pharmacological approaches include the use of oral hypoglycemic drugs such as sulfonylureas, biguanides, and alpha-glucosidase inhibitors (acarbose). Non-pharmacological approaches focus on controlling blood sugar levels through five pillars: health education, medical nutrition therapy, physical activity, pharmacological therapy, and blood sugar monitoring[6].

DM sufferers plan and regulate their meals, physical activity, hypoglycemic medication, and health education as options in monitoring or managing DM. The intervention structure based on the 5 pillars of DM management has been proven to be effective in reducing blood glucose levels in DM sufferers, but its implementation has not been perfect, this is supported by the 2018 Riskesdas data which shows that DM control with physical activity interventions shows a success rate of 48.1% and DM interventions with drugs have a success rate of 91%[7].

A phenomenon in society is that many DM sufferers do not take medication because they feel healthy, are bored with taking medication, often forget to take medication, do not have the money for treatment, and health facilities are far away, so supporting therapy is needed so that the effectiveness of DM therapy is more optimal[8]. Symptoms in DM sufferers who are often hungry cause them not to follow the 3 principles of diet, namely paying attention to the type of food, the amount of nutrients, and the meal schedule, so that blood glucose levels are not controlled[9].

Processed snacks for diabetes sufferers are very supportive in controlling blood glucose levels. Foods containing high amylose and low GI are widely found and developed to treat chronic diseases such as uncontrolled blood glucose levels, including red beans. Red beans are expected to provide effective and more optimal results because they are rich in fiber, high in protein, and low in glucose. Red beans are processed into snacks in the form of cookies. The raw material for red beans is easy to obtain, can provide a savory taste, and aroma to cookies. Red beans contain various inhibitory components such as phytic acid, tannins, trypsin inhibitors, and oligosaccharides. These inhibitors in red beans slow down carbohydrate digestion in the small intestine, and red beans have a lower glycemic index of 26 grams than green beans and soybeans[10].

Red kidney beans are a significant source of fiber, with 4 grams of dried kidney beans per 100 grams. They have a very low glycemic index of 26, compared to mung beans

and soybeans. They are also rich in protein, with 11 grams per 100 grams[10]. Red beans contain anthocyanins, which can increase insulin production, with a total of 7.21 mg of anthocyanins per 100 grams[11]. Red bean cookies are a healthy alternative snack, low in calories and simple carbohydrates for people with diabetes. Their anthocyanin content and low glycemic index mean these cookies can help lower blood sugar levels[10]. Red beans are used to make flour that can replace wheat flour. Red beans are used to make cookies, which aim to make it easier for people with diabetes to choose healthy, safe, delicious snacks without worrying about affecting their glucose levels[12].

METHODS

This study used a Pre-experimental design with a one-group pretest-posttest design. The sampling technique used was non-probability sampling with a purposive sampling method, involving 30 respondents. A data normality test was carried out using the Shapiro-Wilk test, while data analysis used the Wilcoxon and Mann-Whitney tests. The Wilcoxon test was used to analyze changes in fasting blood glucose levels before and after giving red bean cookies, and the Mann-Whitney test was used to analyze differences in changes in fasting blood glucose levels before and after giving red beans. This study was conducted from September 23 to October 14, 2024. Fasting blood glucose levels were measured one day before the intervention, and measurements after the intervention were carried out on the 22nd day. The population in this study consisted of type II diabetes mellitus clients who experienced hyperglycemia, with fasting blood sugar levels ≥ 126 mg / dL, in the working area of the Sukamakmur Community Health Center, Aceh Besar Regency, and participated in the PROLANNIS program. Inclusion criteria included those with type 2 diabetes mellitus for 1 to 5 years, aged 35 to 66 years, fasting blood glucose levels ≥ 126 mg/dL, not receiving insulin therapy, and regularly taking metformin. Exclusion criteria included those with comorbidities such as hypertension, kidney failure, heart disease, and mental disorders. Respondents who were pregnant or had ulcers, as well as those receiving other interventions such as extracts or acupressure, were also excluded from the study.

The composition of red bean cookies with the main ingredients of 50 grams of red bean flour, 15 grams of skim milk flavoring (diabetasol vanilla), 10 grams of egg yolk binder, 30 grams of butter, and 1 gram of vanilla. The process of making cookies is as follows: prepare the ingredients needed. The ingredients are weighed according to the specified formula. A total of 30 grams of butter, 15 grams of skim milk, and 1 gram of vanilla are placed in a baking bowl, then mixed using a mixer until evenly distributed. Next, 1 egg is added to the dough and stirred until evenly mixed. A 50-gram variation of red bean flour according to the formula is then added to the dough. The dough is kneaded until smooth and then divided into portions weighing 25 grams each for each cookie. Each portion of dough is flattened, then baked in a low-heat oven for approximately 1 hour.

The proximate content in 25 grams or 1 piece of cookies is 4.9% protein, 10.2% fat, 32.44% carbohydrates, and 125 kcal. Treatment of giving red bean cookies with a serving size of 50 grams per day was divided into 2 pieces, each 25-gram piece was consumed at 10:00, 1 piece and 1 piece at 16:00, and the patient regularly took the metformine medication prescribed by the doctor 2x500 mg every day for 21 days. The cookies were given one day before the fasting blood glucose level was checked. Food control in patients who received the intervention was carried out using 24-hour food recall data every day for 21 days, written by the patient and analyzed by a nutritionist. Data processing for this study was carried out computerized system using the Wilcoxon and Mann-Whitney tests. In this study, researchers paid attention to research ethics, which include: informed consent, confidentiality, justice, beneficence, and ethical clearance. The research obtained a research permit No.KH.03.01/F.XXIII.18/1328/2024 from the

Head of the Postgraduate Program, accompanied by a research ethics feasibility certificate No.1001/EA/KEPK/2024 from the Ethics Committee of the Ministry of Health Polytechnic of Semarang.

RESULT

Table 1. Respondent Characteristics Data Based on Fasting Blood Glucose Level Measurement Results

KGD	Red bean cookies given (n=30)	
	Mean±SD	Min-Max
GDP pre-test	226.40 ± 64.144	140-389
GDP post-test	186.60 ± 44.803	115-295

Table 1 shows data on respondent characteristics based on the results of glucose level measurements. Fasting blood glucose (BG) before and after administration of red bean cookies to 30 respondents. The average fasting blood glucose level before the intervention (pre-test) was 226.40 mg/dL with a standard deviation of 64.14, and a range of values between 140 and 389 mg/dL. After administration of red bean cookies (post-test), the average fasting blood glucose level decreased to 186.60 mg/dL with a standard deviation of 44.80, and a range of values between 115 and 295 mg/dL. These data indicate a decrease in fasting blood glucose levels after consumption of red bean cookies.

Table 2. Fasting Blood Glucose Level Normality Test

Group	KGD	Statistics	df	P*
Giving Red Beans	Pre-test	0.868	30	0.001
	Post test	0.924	30	0.034

*Shapiro-Wilk Normality Test $p > 0.05$

Table 2 shows the results of the fasting blood glucose (BGL) normality test using the Shapiro-Wilk test in the red bean group, both before (pre-test) and after (post-test) the intervention. The p-value for the pre-test was 0.001, and for the post-test was 0.034, both less than 0.05. This indicates that the fasting blood glucose data in both conditions were not normally distributed.

Table 3. Data Analysis of Changes in Fasting Blood Glucose Levels Before and After Giving Red Bean Cookies

KGD	Pretest (n=30)	Posttest (n=30)	p
	Mean±SD	Mean ±SD	
Giving Red Beans	226,40± 64,946	186,60±44,803	0.001

*Wilcoxon test $p < 0.05$

Table 3 shows the analysis of the results of changes in fasting blood glucose (KGD) levels before and after administering red bean cookies to 30 respondents. The average fasting blood glucose level decreased from 226.40 mg/dL (± 64.95) in the pretest to 186.60 mg/dL (± 44.80) in the posttest. The Wilcoxon test showed a p-value of 0.001, indicating that the decrease in fasting blood glucose levels was statistically significant ($p < 0.05$). The administration of red bean cookies was shown to reduce fasting blood glucose levels in respondents.

Table 4. Analysis of Differences in Changes in Fasting Blood Glucose Levels Before and After Red Bean Administration

KGD	(n=30)	p*
	Mean SD	
GDP pre-test	226.40±64.946	0.201
GDP post-test	186.60 ± 44.803	0.001
Delta	39.80	0.002

*Man Whitney test $p < 0.05$

Table 4 shows a decrease in fasting blood glucose levels from 226.40 mg/dL (pre-

test) to 186.60 mg/dL (post-test) after administering red beans to 30 respondents. This change of 39.80 mg/dL was statistically significant with $p = 0.002$ (Mann-Whitney test, $p < 0.05$), indicating that administering red beans reduced blood glucose levels.

DISCUSSION

The results of the Mann-Whitney test in this study, before (pre-test) administration of red bean cookies, showed a p -value > 0.05 , which indicates no significant difference in fasting blood glucose levels. The results of the statistical analysis showed an average pre-test fasting blood glucose (FBS) level of 226.40 mg/dL and an average post-test FBS of 186.60 mg/dL. Thus, administration of red bean cookies can reduce the average blood glucose by 39.80 mg/dL (17.58%).

This study aligns with research conducted by Yenni Dayanti (2020), in which 35 grams of red beans were given once daily between 3:00 PM and 4:00 PM for 14 days. Blood glucose levels were measured before the intervention on day 1 (pre-test) and after the intervention on day 14 (post-test). The average blood glucose level before consuming red beans was 160.3 mg/dL, which decreased to 158.3 mg/dL after the intervention. The average decrease in blood glucose between the pre-test and post-test was recorded at 1.94 mg/dL, representing a decrease of 1.21% [13]. Red bean cookies (*Phaseolus vulgaris* L.) are an excellent source of dietary fiber, with every 100 grams of dried red beans containing about 4 grams of fiber, both soluble and insoluble. Soluble fiber plays an important role in lowering blood sugar levels by significantly reducing the glycemic response to food. Compared to mung beans and soybeans, red beans contain the most carbohydrates, while having a much lower fat content than soybeans and peanuts, and also contain more fiber than soybeans and peanuts [11]. Red bean cookies contain higher levels of protein and fiber, and lower levels of carbohydrates, compared to wheat flour. The protein and fiber content of red bean cookies exceeds that of wheat flour, but the carbohydrate content is relatively lower [13].

Red bean cookies contain various inhibitory components, such as phytic acid, tannins, trypsin inhibitors, and oligosaccharides. These inhibitors can slow the digestion of carbohydrates in the small intestine, thereby lowering the glycemic index of foods. Fiber plays a role in maintaining the digestion and absorption of carbohydrates in the body [14]. The fiber contained in red bean cookies can inhibit the secretion of glucagon, a hormone that increases blood glucose levels. By inhibiting glucagon release, fiber helps lower blood glucose levels. Fiber can also reduce glucose absorption by the intestines, thereby lowering blood sugar levels. Furthermore, fiber can inhibit the release of glucose from the liver, which also contributes to lower blood glucose levels. Furthermore, the fiber in kidney beans can lower LDL cholesterol levels, which are associated with an increased risk of diabetes mellitus. This reduction in LDL cholesterol helps reduce the risk of diabetes [15], [16].

Red bean cookies are an excellent source of fiber, with every 100 grams of dried red beans containing about 4 grams. Red beans also have the lowest glycemic index, at 26, compared to mung beans and soybeans. Furthermore, red bean cookies contain quite a lot of protein, reaching 11 grams per 100 grams [10]. These cookies are also rich in anthocyanins, with cyanidin content of 1.2 mg per 100 grams and pelargonidin of 2.4 mg per 100 grams. The total anthocyanin content in red beans is 7.21 mg per 100 grams [11]. Cookies made from red beans serve as a source of vegetable protein that can help prevent non-communicable diseases and support government programs in treating diabetes mellitus through nutritional therapy, with lower gas emissions compared to animal protein sources.

The advantages of red beans when processed into cookies include their easy preparation, long shelf life, portability, and popularity as a consumer snack. These cookies are made using natural food additives. Cookies are easy to carry, long-lasting, cookies can be stored at room temperature without losing their quality, and are a practical

choice for daily snacks without preservatives. Red beans provide a savory taste and a more complex texture, making cookies more delicious and attractive to respondents. The taste of red bean cookies is not liked by some respondents, as there is a distinctive smell, so some respondents feel bored if consumed for a long time. The weakness of this study has been conducted on food intake data with food recall and analysis by nutritionists, but it is difficult to control the intake and eating habits of the community.

CONCLUSION

Giving 50 grams of red bean cookies has been proven to reduce fasting blood sugar (FBS) levels by up to 39.80 mg/dL, or 17.58%. Fasting blood sugar levels before the intervention averaged 226.40 mg/dL, and after the intervention, they became 186.60 mg/dL. Although this decrease in blood glucose levels has not reached the normal limit, the normal fasting blood glucose level is 126 mg/dL. The results of the statistical test showed a p-value = 0.000, meaning there is a significant difference. Red bean cookies are a practical solution as an alternative healthy snack product with a low glycemic index that can control fasting blood glucose levels in people with type II diabetes mellitus.

Giving 50 grams of red bean cookies for 21 days showed a decrease, but not yet reached a decrease within the normal range. The taste of red bean cookies is not preferred by some respondents, so some respondents feel bored if consumed over a long period of time. For future researchers, it is hoped that the addition of toppings or supporting ingredients that are safe for blood glucose levels to provide a more significant decrease within the normal range and add a more delicious taste, and disguise the unpleasant taste so that respondents do not feel bored if consumed over a long period. Cookies made from red beans that can be an alternative additional nutritional therapy in addition to pharmacological therapy in the management of diabetes mellitus are programmed prolannis, which can lower blood glucose levels.

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