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DOI: [10.31965/infokes.Vol23.Iss4.1912](https://doi.org/10.31965/infokes.Vol23.Iss4.1912)Journal homepage: <https://jurnal.poltekkeskupang.ac.id/index.php/infokes>**RESEARCH****Open Access****Effectiveness of Purple Sweet Potato and Red Bean Cookies on Fasting Blood Glucose Levels in Patients with Type II Diabetes Mellitus****Maqhfiratul Ulfa^{1a*}, Rr Sri Endang Pujiastuti^{2b}, Mardiyono^{2c}, Emad Mousay Mohammed Amkhatirah^{3d}**¹ Nursing Study Programme, Bachelor of Nursing, Universitas Bina Bangsa Getsempena, Banda Aceh City, Aceh, Indonesia² Nursing Study Programme, Postgraduate Programme, Poltekkes Kemenkes Semarang, Semarang, Central Java, Indonesia³ Public Health Programme, Shandong University, Jinan, Shandong Province, China^a Email address: maqhfiratululfa95@gmail.com^b Email address: rarastuti@yahoo.com^c Email address: muh.mardiyono@gmail.com^d Email address: emadmosa465@gmail.com

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Abstract

The worldwide prevalence of diabetes mellitus (DM) continues to climb yearly, with 1.5 million fatalities directly related to DM each year. The number of common instances of DM has been progressively growing during the last several decades. Poor dietary management in people with DM is one of the difficulties that commonly leads to uncontrolled blood glucose levels. Purple sweet potato and red bean cookies are utilized as an alternative treatment for persons with DM because purple sweet potatoes and red beans offer benefits in the form of a low glycemic index and high anthocyanin and fibre content. The goal of this research was to show the efficacy of purple sweet potato and red bean cookies on fasting blood glucose levels in individuals with type II diabetes mellitus. This research approach is a randomized control trial with a pretest-posttest design. Research includes 60 respondents split into 2 groups, utilizing a basic random selection approach. The research was performed for 21 days from 23 September to 13 October 2024 at the Sukamakmur health center region, Aceh Besar. This research employed a pre-test post-test difference test utilizing the Wilcoxon test, and the test across groups using the Mann-Whitney test. The findings of the pre-test average fasting blood sugar levels of intervention group respondents revealed results of 230.07 mg/dL to 152.10 mg/dL post-test (p 0.000), whereas the control group average pretest GDP 226.40 mg/dL to 186.60 mg/dL post-test (p 0.001). This research revealed significant changes in both the intervention and control groups before and after treatment. Statistical findings indicated that purple sweet potato and red bean cookies were more successful in decreasing blood glucose levels than purple sweet potato 104-gram cookies. Purple sweet potato and red bean cookies are excellent to be utilized as nutritious and practical snacks as a support system for persons with DM.

Keywords: Blood Glucose, Diabetes Mellitus, Purple Sweet Potato, Red Bean.**Corresponding Author:**

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1. INTRODUCTION

Diabetes mellitus (DM) represents a major worldwide public health concern. The growing worldwide incidence of diabetes mellitus is predicted to disproportionately impact emerging nations and entail severe health and economic consequences. Approximately one in ten individuals worldwide is affected by diabetes mellitus (DM). Moreover, DM ranks as the third leading cause of mortality, with its prevalence and associated mortality increasing annually ([International Diabetes Federation, 2021](#)). The annual increase in the number of individuals affected by diabetes mellitus (DM) represents a growing public health concern for the global population.

According to the International Diabetes Federation ([International Diabetes Federation, 2021](#)), the global prevalence of diabetes. The International Diabetes Federation (2021) reports that the prevalence of diabetes mellitus rose from 151 million people (4.6%) in 2000 to 537 million people (10.5%) in 2019. By 2030, it is expected to reach 643 million people (11.3%). Additionally, diabetes mellitus is directly responsible for around 1.5 million fatalities annually ([International Diabetes Federation, 2021](#)). The prevalence of DM based on Basic Health Research (Riskesdas) in 2018, the results of measurements in the population aged ≥ 15 years of DM in Indonesia reached 8.5 % in 2018, revealed that the DM prevalence climbed further to 10.9%. (Riskesdas Jawa Tengah, 2018) Aceh province has the 7th highest number of patients with DM in Indonesia ([Badan Penelitian dan Pengembangan Kesehatan, 2018](#)). Patients with diabetes mellitus in 2022 roughly 189,464 cases in Aceh province, of which got care according to norms as many as 108,684 cases or as much as 57.36% ([Dinas Kesehatan Provinsi Aceh, 2022](#)).

Inadequate treatment of DM leads to complications that impact the whole body owing to uncontrolled blood glucose levels. Orem's concept suggests that diabetes mellitus self-care is the capacity of people to take care of themselves and do self-care to enhance blood glucose management. Diabetes mellitus control, such as dietary management, is important to minimize problems by maintaining blood sugar levels within acceptable ranges. ([Alligood, Hamid, & Ibrahim, 2017](#)). The high incidence of DM is associated with lifestyle changes due to the influence of social factors and urbanisation. Unhealthy lifestyles such as eating fast food, physical inactivity, smoking, and poor diet management are some of the contributing factors ([Armalia & Herawati, 2020](#)). Difficulty keeping blood glucose levels within normal ranges owing to lack of dietary discipline or inability to minimize the quantity of food calories ([Herikzah, Pudiastuti, & Widiyanto, 2024](#)).

Many patients with DM demonstrate poor medication adherence due to perceived good health, treatment fatigue, forgetfulness, financial limitations, and limited access to health services, highlighting the need for supportive interventions to optimize therapeutic outcomes. ([Ariska, 2019](#)). Symptoms in DM patients who are frequently hungry cause them not to carry out the 3 principles of diet, namely by paying attention to the quantity of nutrients, kinds of food, and meal times, so that blood glucose levels are not regulated ([Dwipajati et al., 2022](#)).

Processed snack foods designed for individuals with DM, especially those with high amylose content and a low glycemic index, are significant for blood glucose regulation and have been extensively developed to address chronic conditions like hyperglycemia, including items made from purple sweet potatoes and red beans ([Dwipajati et al., 2022](#)). Purple sweet potato (*Ipomoea batatas* L) contains high levels of anthocyanins, which are antidiabetic. Purple sweet potato contains the anthocyanins cyanidin, peonidin, and pelargonidin. The hormone incretin promotes insulin production and the proliferation of pancreatic β -cells, hence aiding in the reduction of blood glucose levels ([Yang et al., 2021](#)). The anthocyanin concentration in purple sweet potatoes is 11.45 milligrams per 100 grams ([Arisanti et al., 2023](#)).

Research performed by Rhea revealed that administering d'bingu pudding (100 grams of purple sweet potato) on three consecutive days resulted in average blood glucose levels of 221.87 mg/dl in the treatment group and 250.03 mg/dl in the control group. The treatment group exhibited values of 275.17 ± 62.04 and 221.87 ± 0.80 , whereas the comparison group had values of 263.77 ± 38.35 and 250.30 ± 28.58 . Purple sweet potato substantially lowers blood glucose levels (Gipyapuri, Susyani, & Terati, 2020).

The combination of purple sweet potato and red bean is anticipated to provide more appropriate outcomes, since red beans are abundant in fiber, high in protein, and low in glucose. Red beans are readily available, enhancing the flavor and scent of cookies. Red beans contain many inhibitory constituents, including phytic acid, tannins, trypsin inhibitors, and oligosaccharides. The inhibitors in red beans impede glucose breakdown in the small intestine, thus red beans possess a lower glycemic index compared to mung beans and soybeans (Chan et al., 2020).

Red beans are a significant source of fibre; each 100 g of dried red beans contains 4 g of fibre. The glycemic index of red bean is very low at 26, compared to mung bean and soy bean. Protein in red bean is quite high at 11 g/100 g (Zaddana et al., 2021). Red bean also contains anthocyanins that can increase insulin production. The total amount of anthocyanins in red bean is 7.21 mg/100 grams. Giving red bean processed food made from red bean showed significant analysis results, $p\text{-value} > 0.05$ showed a decrease in blood glucose levels in patients with type II diabetes mellitus (Chan et al., 2020).

Purple sweet potato and red bean cookies serve as a nutritious snack option that is low in calories and simple carbs, suitable for those with diabetes mellitus. Purple sweet potato and red bean cookies are rich in anthocyanins and possess a low glycaemic index, both of which may lower blood glucose levels (Zaddana et al., 2021). The use of purple sweet potato and red bean is to produce flour that can substitute wheat flour. Processed flour may be used to create cookies. Cookies are designed to facilitate the selection of nutritious and palatable snacks for those with diabetes, alleviating concerns over glucose level fluctuations (Noer et al., 2022). Cookies are convenient treats that may be enjoyed at any time and in any location. The cookie-making process necessitates very basic technology and materials, and it offers a longer shelf life compared to other baked goods like cakes, pastries, and breads (Noer et al., 2022). The goal of this research was to show the efficacy of purple sweet potato and red bean cookies on fasting blood glucose levels in individuals with type II diabetes mellitus.

2. RESEARCH METHOD

The study was conducted using a randomized control group design with pretest and posttest procedures. From September 23 until October 14, 2024, researchers carried out this study. Patients enrolled in the PROLANNIS program at the Sukamakmur Health Centre in Aceh Besar Regency who had type II diabetes mellitus and fasting blood sugar hyperglycaemia of 126 mg/dL or above were the subjects of this research. Using the Lemeshow method, we can see that there were a total of 54 responders across the two groups, with 27 people responding to each. In order to account for any attrition during sampling, the researcher will round up the total number of respondents to 60 by 10%. This research employed simple random sampling to pick 60 participants for each of the two groups. Thirty people participated in the study; the same number served as a control group. A desire to participate as a responder, having type II diabetes mellitus for 1 to 5 years, being between the ages of 35 and 66, having a fasting blood sugar level of 126 mg/dL or above, not being on insulin treatment, and regularly taking metformine were all inclusion criteria. People who don't meet the requirements to participate include those who have hypertension, renal failure, heart disease, mental disorders, are pregnant, have ulcers, or are participating in any other intervention that doesn't involve eating purple sweet potato cookies and red beans. Research ethics, such as informed consent, secrecy, justice, charity, and ethical authorization, are carefully considered in this work. The study was approved by the

Head of the Postgraduate Program and the Ethics Committee of the Ministry of Health of Semarang Polytechnic. The research permission number is KH.03.01/F.XXIII.18/1328/2024. The study was also accompanied by a certificate of research ethical feasibility number 1001/EA/KEPK/2024. Additional therapies may use techniques such as acupressure and extracts.

The intervention group received therapy via the provision of purple sweet potato and red bean cookies for a duration of 21 days. In the intervention therapy, clients ingest purple sweet potato and red bean cookies, totaling 104 grams daily, split into four 26-gram portions. Each client consumes two pieces at 10:00 and two pieces at 16:00, while also receiving metformin medication. The control group got purple sweet potato cookies at the same dosage and administration time, whereas the patient was given metformin.

The formulation of purple sweet potato and red bean cookies has the following principal ingredients: 54 grams of sweet potato flour, 50 grams of red bean flour, 10 grams of skim milk flavoring (Diabetasol vanilla), 15 grams of egg yolk binder, 50 grams of butter, and 1 gram of vanilla. 104 grams of purple sweet potato cookies, 10 grams of skimmed milk flavoring (Diabetasol vanilla), 15 grams of egg yolk binder, 50 grams of butter, and 1 gram of vanilla.

Data on respondents' characteristics, normality assessment using the Shapiro-Wilk test, and data processing for this research were conducted using computerized Wilcoxon and Mann-Whitney tests.

3. RESULTS AND DISCUSSION

Table 1. Data Characteristics of Respondents

Characteristics	Intervention (n=30)	Control (n=30)
	n(%)	n(%)
Age		
Late Adulthood	4 (13.3%)	5 (16.7%)
Early elderly	18 (60.0%)	19 (63.3%)
Late elderly	8 (26.7%)	6 (20.0%)
Gender		
Man	10 (30.0%)	19 (63.3%)
Woman	20 (70.0%)	11 (36.7%)
Education		
Elementary School	4 (13.3%)	6 (20.0%)
Junior High School	9 (30.0%)	3 (10.0%)
Senior High School	9 (30.0%)	13 (43.3%)
College	8 (26.7%)	8 (26.7%)
Occupation		
Housewife	8 (26.7%)	10 (33.3%)
Retired	2 (6.7%)	1 (3.3%)
Government Employees	4 (13.3%)	5 (16.7%)
Laborer	13 (43.3%)	8 (26.7%)
Private	3 (10.0%)	6 (20.0%)
Body Mass Index (BMI)		
Underweight	4 (13.3%)	4 (13.3%)
Normal	8 (26.7%)	15 (50.1%)
Overweight	17 (56.7%)	10 (33.3%)
Obesity	1 (3.3%)	1 (3.3%)

Table 1 indicates that the average age within each group, namely in the early elderly category of 46-55 years, comprises 60% of the intervention group and 63.3% of the control group. The predominant demographic of respondents was female, comprising 70.0% in the intervention group and 36.7% in the control group. The predominant education levels were junior high school and high school, with 30.0% in the intervention group and 43.3% in the control group at the high school education level. The work characteristics of the respondents indicated that 43.3% were laborers in both the intervention and control groups, while housewives constituted 33.3%. The respondents' BMI characteristics indicated that 56.7% of the intervention group and 33.3% of the control group were mostly overweight.

Table 2. Data Characteristics of Respondents Based on Fasting Blood Glucose Level Measurement Results.

Blood Glucose Levels	Intervention (n=30)		Control (n=30)	
	Mean SD	Min-Max	Mean SD	Min-Max
Fasting blood glucose pre-test	230.07 ± 6.449	141-321	226.40 ± 64.144	140-389
Fasting blood glucose post-test	152.10 ± 38.802	102-293	186.60 ± 44.803	115-295

Table 2 demonstrates that the pre-test data showed an average fasting blood sugar level of 230.07 mg/dL in the intervention group, whereas the post-test level was 152.10 mg/dL. The pre-test control group had an average GDP of 226.40 mg/dL, whereas the post-test GDP average was 186.60 mg/dL.

Table 3. Normality Test of Fasting Blood Glucose Levels

Group	Blood Glucose Levels	Statistic	df	p-value*
Intervention	Pre test	0.910	30	0.015
	Post test	0.850	30	0.001
Control	Pre test	0.868	30	0.001
	Post test	0.924	30	0.034

*Normality Test Shapiro-Wilk $p > 0.05$

Table 3 shows that the results of the normality test for the pretest and posttest GDP variables in both the intervention and control groups indicate that $p < 0.05$, indicating that the data are not normally distributed.

Table 4. Data Analysis of Changes in Fasting Blood Glucose Levels Before and After Treatment in the Intervention Group and Control Group

Group	Pretest (n=30)	Posttest (n=30)	p-value
	Mean ± SD	Mean ± SD	
Intervention	230.07±46.449	152.10±38.802	0.000
Control	226.40±64.946	186.60±44.803	0.001

*Wilcoxon Test $p < 0.05$

Table 4 shows that the Wilcoxon test findings indicated a reduction in blood glucose levels before and after the test in both groups. The intervention group exhibited a p-value of 0.000, indicating that the administration of purple sweet potato and red bean cookies significantly reduced fasting blood glucose levels ($p < 0.05$). The control group exhibited a p-value of 0.001, indicating that the intervention, including purple sweet potato cookies, had a

meaningful effect; however, the reduction in fasting blood glucose levels was not as significant as in the intervention group.

Table 5. Analysis of Differences in Changes in Fasting Blood Glucose Levels Before and After Treatment of Intervention and Control Groups, and the effect size.

Blood Glucose Levels	Intervention (n=30)	Control (n=30)	p*	Cohen's d effect
	MR±SR	MR±SR		
Pre-test fasting blood levels	230.07± 46.449	152.10± 38.802	0.201	0.82
Post-test fasting blood levels	226.40± 64.946	186.60± 44.803	0.001	
Delta	77.97± 6.683	39.80± 12.654	0.002	

*Mann Whitney Test $p < 0.05$

Table 5 shows that the Mann-Whitney test results showed pretest results of fasting blood glucose levels in the intervention group and control group, $p > 0.05$, which shows there is no difference. Post-test showed a significant difference in $p > 0.05$ between fasting glucose levels in the intervention group and the control group. The effect size value of the difference between the intervention group and the control group was 0.82 (Moderate). This value is categorised as moderate. This study explains that giving purple sweet potato and red bean cookies in effect size has the potential to reduce fasting blood glucose levels in patients with type II diabetes mellitus.

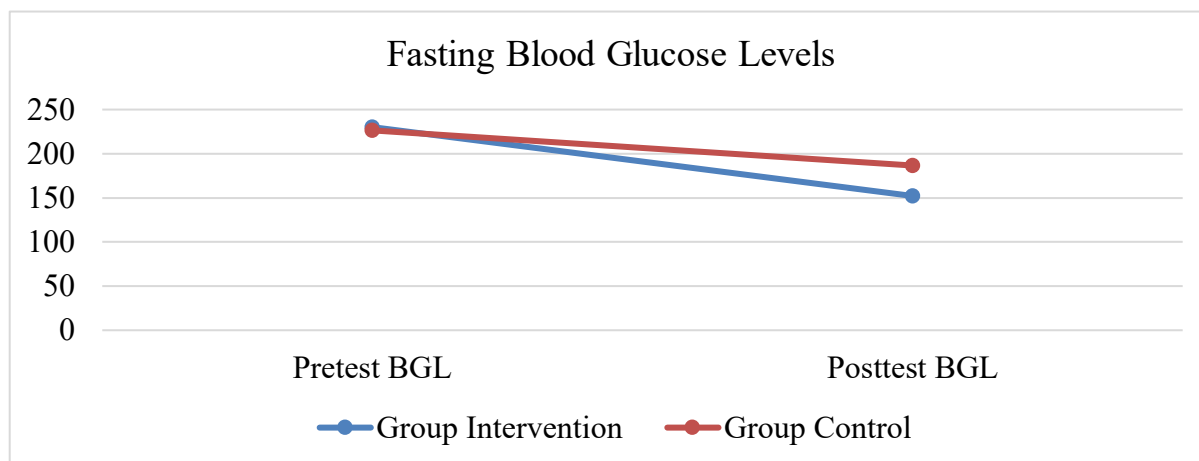


Figure 1. Difference in Mean Fasting Blood Glucose Levels Before and After Treatment in Intervention and Control Groups.

Figure 1 shows that the intervention group (blue line) and the control group (red line) have the same decrease in fasting blood glucose levels. The intervention group had a greater reduction compared to the control group. The decrease in fasting blood glucose levels in the intervention group averaged 230.07 mg/dL before treatment to 152.10 mg/dL after treatment, while in the control group, the decrease in fasting blood glucose levels averaged 226.40 mg/dL before treatment to 186.60 mg/dL after treatment.

The majority of respondents in this research were in the early elderly decade, between 46 and 55 years, in conformity with the results of those who indicated that cases of type 2 diabetes mellitus often occur in those over 30 years of age. The risk of diabetes rises with age, particularly after 40 years, with persons over 45 years having a greater chance of suffering

uncontrolled blood glucose levels (OR 18.143) than those under 45 years of age. Increased fasting blood glucose levels in the elderly are caused by cell degradation, specifically a reduction in the activity of pancreatic β cells that make insulin, as well as a loss in mitochondrial function of up to 35%. In addition, a rise in fat levels of roughly 30% in this age range also leads to insulin resistance (Fatria, Maidar, & Arifin, 2022)

The majority of respondents in the study were women, with percentages ranging from 56.7% to 90%, demonstrating that women are more commonly diagnosed with diabetes mellitus than males. Other studies suggest that 59.4% of diabetes patients are women, especially those who are obese. Hormonal and metabolic variations between genders, especially in postmenopausal women who suffer alterations in glucose metabolism, contribute to this high frequency. Women are more sensitive to obesity, a primary risk factor for type 2 diabetes, with an elevated Body Mass Index (BMI) more frequently in women. Furthermore, hormonal changes during menopause increase the likelihood of insulin resistance, making body cells less receptive to insulin and leading to elevated blood glucose levels (Komariah & Rahayu, 2020).

Most respondents in the study had a junior high school background, expressing their desire for an immediate job rather than pursuing their education. They lacked understanding about health, especially diabetes mellitus, such as the signs and symptoms of high blood sugar levels and foods that might elevate blood glucose. Education has a significant role in establishing knowledge, habits, and lifestyle, and impacts a person's capacity to assimilate information and control diabetes. Research demonstrates that education level and frequency of health education substantially impact blood glucose management behaviors in patients with diabetes. The respondents in this research were housewives who conducted light physical tasks inside, such as cooking, washing, and sweeping, with minimal physical activity outside the home. Research reveals that employment with minimal physical activity, such as light housekeeping or office work, is associated with an increased risk of high blood glucose levels owing to less efficient glucose regulation, therefore raising the risk of diabetes (Aranía et al., 2021). This study showed that the majority of respondents had a BMI above normal, including overweight and obesity, which affects blood glucose levels. Obesity contributes up to 55% to the development of type 2 diabetes due to increased abdominal fat, which releases adipoquinones and inflammatory substances, thereby reducing insulin receptor sensitivity.

Differences in Fasting Blood Glucose Levels Before and After Giving Purple Sweet Potato Cookies and Red Bean to Type II Diabetes Mellitus Patients

The statistical test results indicate that the intervention group, after consuming purple sweet potato cookies and red bean, experienced an average decrease in fasting blood glucose levels to 77.97 mg/dL (33.89%), while the control group exhibited an average decrease to 39.80 mg/dL (17.58%). The decrease in fasting blood glucose levels was more pronounced in the intervention group compared to the control group. Research by Nurhayati indicated that pastries composed of purple sweet potato flour and tempe flour influenced blood glucose levels in patients with type II diabetes mellitus at Dr. Tadjuddin Chalid Hospital, Makassar. The mean blood glucose level of 12 participants before the intervention was 289 mg/dl, but post-consumption of the cake, it was measured at 229 mg/dl. Purple sweet potato is an excellent source of carbs and is abundant in fiber and beta-carotene. The carbohydrates in purple sweet potato have a low glycemic index of 44, which might decelerate glucose absorption and diminish insulin release, hence preventing fluctuations in blood glucose levels (Muslimin, Fanny, & Manjilala, 2018).

Research shows that purple sweet potato has a hypoglycaemic effect on type II diabetes mellitus. In a study conducted by Novianti, the administration of purple sweet potato reduced blood glucose levels by 16.5% compared to the control group of 10.3%. This study proved the antihyperglycaemic effect of anthocyanins, which can inhibit the activity of maltase enzyme in

the process of blood glucose production. Research conducted by Muslimin et al. (2018), showed that the provision of pastries made from purple sweet potato flour and tempe flour had an impact on blood sugar levels in type II diabetes mellitus patients at Dr. Tadjuddin Chalid Hospital, Makassar. The average blood sugar level of 12 respondents before the intervention was 289 mg/dl after consuming the cake was recorded at 229 mg/dl. Purple sweet potato is a good source of carbohydrates and is rich in fibre and beta carotene. Purple sweet potato has a low glycaemic index (GI) of 44, which helps keep blood sugar levels stable. The carbohydrates are absorbed slowly and minimise excessive insulin release (Muslimin, Fanny, & Manjilala, 2018).

Purple sweet potato research shows has a hypoglycaemic effect on type 2 diabetes mellitus. In a study conducted by Novianti, the administration of purple sweet potato reduced blood glucose levels by 16.5% compared to the control group of 10.3%. This study proved the antihyperglycaemic effect of anthocyanins, which can inhibit the activity of maltase enzyme in the process of blood glucose production. Research shows Zaddana et al. (2021) that red beans contain various inhibitory components such as phytic acid, tannins, trypsin inhibitors, and oligosaccharides. These inhibitory substances can slow down the process of carbohydrate digestion in the small intestine. Red bean can be an important food choice, especially for individuals at risk or with type II DM. Red beans are a good source of fibre, with every 100 grams of dried red beans providing 4 grams of fibre. Red beans are high in protein, which is about 11 grams per 100 grams. The dietary fibre and resistant starch content in red bean fibre can increase the viscosity of food in the digestive tract and slow the absorption of sugar. This effect could potentially help lower blood sugar levels (Kementerian Kesehatan Republik Indonesia, 2018).

Supporting factors that play a role in an individual's ability to perform self-care are important in reducing fasting blood sugar levels in patients with type II diabetes mellitus. Self-care in diabetes mellitus involves individual actions to control blood glucose and prevent vascular complications, which include medication management (Garedow et al., 2023). Self-care plays an important role for patients with type II diabetes mellitus to prevent complications. Patient self-care is in line with Orem's theory, which emphasises the role of individuals in meeting self-care needs to achieve optimal well-being (Cita, & Yuanita, 2019). The application of Dorothea Orem's self-care theory in diabetes mellitus (DM) patients focuses on empowering individuals to effectively manage their health. This approach aims to empower patients to be more independent in carrying out self-care, particularly in terms of diet, exercise, and blood glucose monitoring. Orem's theory is applied by encouraging patients to be active in their disease management, monitor blood sugar levels, maintain a healthy diet, and exercise regularly. The approach proved to be effective in improving the quality of life of DM patients with acute complications (Maina, et al., 2023).

Effectiveness of Giving Purple Sweet Potato and Red Bean Cookies 104 grams in Patients with Type II Diabetes Mellitus

This research demonstrated that administering 104 grams of purple sweet potato and red bean cookies to individuals with type II diabetes mellitus over 21 consecutive days significantly reduced fasting blood glucose levels, yielding a p-value of 0.001. The research revealed that the pre-test average fasting blood sugar levels in the intervention group were 230.07 mg/dL, whereas the control group had an average of 152.10 mg/dL. The average post-test fasting blood sugar levels were 226.40 mg/dL in the intervention group and 186.60 mg/dL in the control group. The average result is clinically significant, with normal fasting blood glucose levels below 126 mg/dL, indicating its importance in lowering fasting blood glucose levels in patients with type II diabetes mellitus within the Sukamakmur health center region, Aceh Besar.

Administering 104 grams of purple sweet potato cookies and red bean can effectively lower fasting blood glucose levels over 21 days, as shown by a modest effect size of 0.82, represented by Cohen's *d*. An impact size of 0.82 indicates a modest effect size. The findings indicate a clinically meaningful difference in the lowering of fasting blood glucose levels among individuals with type II diabetes mellitus. The process by which purple sweet potato and red bean cookies affect fasting blood glucose levels involves the inhibition of the enzymes α -amylase and α -glucosidase, hence decelerating the absorption of monosaccharides from meals. Mitigating hyperglycemia enhances insulin sensitivity due to a reduction in the absorption of monosaccharides by the intestines. This enzyme facilitates the degradation of complex carbs into simple glucose. By inhibiting this enzyme, anthocyanins facilitate a reduction in glucose absorption throughout the digestive system, thereby lowering fasting blood glucose levels. The incorporation of red bean flour may impede the digestion and absorption of carbohydrates in the small intestine, hence aiding in the stabilization of blood glucose levels. (Arisanti, et al., 2023).

The decrease in fasting blood glucose levels is caused by the anthocyanin content, which can increase insulin sensitivity. The body's cells become more responsive to insulin, helping in the uptake of glucose from the blood into the cells. Research shows that anthocyanins can protect pancreatic β cells from glucose-induced oxidative stress, potentially preventing insulin resistance. Anthocyanins contribute to the activation of AMP-activated protein kinase (AMPK), which is an important pathway in energy metabolism. AMPK activation increases glucose transport to skeletal muscle and reduces blood glucose levels by facilitating the use of glucose by body cells. Anthocyanins have strong antioxidant properties, which help reduce oxidative stress in the body. Oxidative damage, anthocyanins can improve metabolic conditions and support pancreatic health, thus contributing to the control of blood glucose levels. Anthocyanins protect pancreatic cells from free radical damage, which occurs in people with diabetes. This protection is important for maintaining the function of the pancreas in producing insulin effectively (I'tishom, et al., 2021).

This study shows that giving purple sweet potato cookies and red bean is effective in reducing fasting blood glucose levels compared to the study of giving purple sweet potato snack bars. The results of the pre-test fasting blood sugar levels on average in the intervention group with a GDP value of 230.07 mg / dL, Post-test with an average GDP of 152.10 mg / dL. The control group pre-test GDP average of 226.40 mg / dL post-test GDP 186.60 mg / dL. Research (Gipyapuri et al., 2020), The Effect of Giving D'Bingu Pudding on Reducing Blood Sugar Levels in Type 2 DM Patients. Giving 100 grams of purple sweet potato, with a significant result of 0.000, with an average blood sugar level before treatment of 275.17 mg/dl and after intervention of 221.87 mg/dl, which means that purple sweet potato pudding is effective in reducing blood sugar levels in type II diabetes mellitus patients.

The conclusion in comparing the results of the researcher's research with other researchers using the effect size calculation in the study of giving purple sweet potato cookies and red bean on fasting blood glucose levels in type II DM patients has an effect size of 0.82 (moderate), this study is better than the previous study conducted by Rhea whose effect size was 0.50 which means that giving purple sweet potato pudding has a weak effect on blood glucose levels. The results of statistical tests conducted by Rhea and researchers both showed significant differences (<0.05). The results of the Cohen's effect size calculation showed that the research conducted by Rhea had a lower effect size value compared to the intervention study of consuming purple sweet potato cookies and red bean, which means that consuming purple sweet potato cookies and red bean has a greater effect on fasting blood sugar levels compared to giving purple sweet potato pudding without a combination of red bean. Research with the provision of purple sweet potato pudding, the manufacturing process is complicated, and requires time to cool before serving. Pudding has a soft texture.

The durability of the pudding is not long-lasting, not practical to carry anywhere. Pudding must be refrigerated to maintain its freshness. Purple sweet potato and red bean cookies are easy to carry, durable, cookies can be stored at room temperature without losing their quality, and are a practical choice for daily snacks without preservatives. The combination of purple sweet potatoes and red bean provides a savory taste and a more complex texture, making cookies more delicious and attractive to respondents. Purple sweet potato and red bean cookies contain more fiber and protein due to the addition of red bean flour, red bean flour can help increase satiety and support digestive health. The combination of purple sweet potato flour and red bean flour produces cookies with a low glycemic index. Purple sweet potato and red bean cookies are not only delicious, but also more nutritious than cookies made only from purple sweet potatoes.

4. CONCLUSION

The administration of purple sweet potato and red bean cookies was shown to effectively reduce fasting blood glucose levels in patients with diabetes mellitus. Compared with the control group that received purple sweet potato cookies alone, the combination intervention demonstrated a greater reduction in fasting blood glucose levels. Statistical analysis confirmed that this reduction was significant, indicating that the addition of red bean flour enhanced the glycemic-lowering effect of purple sweet potato cookies. Overall, the combined intervention exhibited a moderate and clinically meaningful effect, suggesting its potential as a functional food option for supporting blood glucose control in diabetic patients.

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