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Effect of Pumpkin (*Cucurbita moschata*) and Red Kidney Bean (*Phaseolus vulgaris* L.) Cookies on Blood Glucose Levels in Patients with Type 2 Diabetes Mellitus

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Abstract

Non-pharmacological dietary interventions are important for improving glycemic control in patients with type 2 diabetes mellitus (T2DM). Pumpkin (*Cucurbita moschata*) and red kidney beans (*Phaseolus vulgaris* L.) are rich in dietary fiber and bioactive compounds that may help reduce blood glucose levels. This study aimed to evaluate the effect of pumpkin and red kidney bean cookies on random blood glucose levels in patients with T2DM. A quasi-experimental study with a pretest–posttest control group design was conducted among 48 patients, who were assigned to an intervention group (n = 24) and a control group (n = 24). The intervention group consumed 40 g/day of pumpkin and red kidney bean cookies for seven consecutive days, while the control group received no intervention. Random blood glucose levels were measured before and after the intervention and analyzed using the Wilcoxon Signed-Rank Test and Mann–Whitney U Test. The intervention group showed a mean reduction in random blood glucose of 15.37 mg/dL, compared with 0.21 mg/dL in the control group. A significant reduction was observed in the intervention group ($p = 0.001$), whereas no significant change occurred in the control group ($p = 0.577$). Between-group analysis also demonstrated a significant difference ($p = 0.001$). These findings indicate that pumpkin and red kidney bean cookies may serve as a promising functional snack to support glycemic control in patients with T2DM.

Keywords: blood glucose, functional food, pumpkin, red kidney bean, type 2 diabetes mellitus.

Introduction

Diabetes mellitus (DM) type 2 is a chronic metabolic disorder characterized by persistent hyperglycemia resulting from impaired insulin secretion, insulin resistance, or both. The prevalence of type 2 DM continues to increase worldwide, making it one of the leading causes of morbidity and premature mortality due to cardiovascular disease, nephropathy, retinopathy, and neuropathy. According to the International Diabetes Federation (IDF), approximately 589 million adults aged 20–79 years were living with diabetes in 2024, and this number is projected to increase to 853 million by 2050. More than 90% of diabetes cases are type 2 diabetes, with the greatest burden occurring in low- and middle-income countries (IDF, 2025). In Indonesia, diabetes remains a major public health concern, ranking among the countries with the largest number of adults living with diabetes worldwide (IDF, 2025).

Persistent hyperglycemia promotes oxidative stress, chronic inflammation, and endothelial dysfunction, thereby accelerating the development of both microvascular and macrovascular complications. Therefore, nutritional management is considered one of the cornerstones of diabetes care, alongside physical activity and pharmacological treatment. Current dietary recommendations emphasize the consumption of foods rich in dietary fiber,

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antioxidants, and low-glycemic-index carbohydrates to improve glycemic control and reduce the risk of diabetes-related complications (American Diabetes Association, 2025).

Pumpkin (*Cucurbita moschata*) is a promising functional food because it contains dietary fiber, pectin, carotenoids, polyphenols, vitamins, and minerals that contribute to glycemic regulation. Experimental and clinical studies have demonstrated that pumpkin bioactive compounds may reduce blood glucose by improving insulin sensitivity, delaying gastric emptying, reducing glucose absorption, and protecting pancreatic β-cells through antioxidant mechanisms (Amin et al., 2023). Likewise, red kidney beans (*Phaseolus vulgaris* L.) are recognized as low-glycemic-index legumes that provide resistant starch, soluble fiber, plant protein, and polyphenolic compounds. These components slow carbohydrate digestion and inhibit digestive enzymes such as α-amylase and α-glucosidase, thereby reducing postprandial glucose excursions (Becerra-Tomás et al., 2018; Wang et al., 2022).

Combining pumpkin and red kidney beans into cookies offers an attractive strategy for developing functional snack foods for individuals with type 2 diabetes. Cookies are widely accepted by consumers, have a relatively long shelf life, are convenient for daily consumption, and can serve as healthy between-meal snacks. The incorporation of pumpkin and red kidney bean flour may improve the nutritional quality of cookies by increasing dietary fiber, antioxidant capacity, and protein content while lowering their glycemic response compared with conventional wheat-based cookies (Kurek et al., 2022).

Although numerous studies have investigated the hypoglycemic potential of pumpkin or legumes individually, evidence regarding the combined effect of pumpkin (*Cucurbita moschata*) and red kidney bean (*Phaseolus vulgaris* L.) cookies on blood glucose levels among patients with type 2 diabetes remains limited, particularly in Indonesian primary healthcare settings. Therefore, this study aimed to evaluate the effect of pumpkin and red kidney bean cookies on random blood glucose levels among patients with type 2 diabetes in the working area of Kajhu Community Health Center, Aceh, Indonesia.

Methods

This quantitative study employed a quasi-experimental design using a pretest–posttest control group design. The study was conducted in the working area of Kajhu Community Health Center (Puskesmas Kajhu), Aceh, Indonesia. Participants were selected using a purposive sampling technique based on predetermined inclusion and exclusion criteria. A total of 48 patients with type 2 diabetes mellitus were enrolled and equally allocated into an intervention group (n = 24) and a control group (n = 24).

Participants in the intervention group received four pumpkin (*Cucurbita moschata*) and red kidney bean (*Phaseolus vulgaris* L.) cookies (40 g/day) for seven consecutive days. The daily portion was divided into two servings, consisting of two cookies at 10:00 AM and two cookies at 4:00 PM, to facilitate adherence and maintain a consistent distribution of carbohydrate intake throughout the day. The snack portion was designed to provide approximately 23.4 g of carbohydrates, which is consistent with the National Diabetes Services Scheme (NDSS, 2023) recommendation that snacks for individuals with type 2 diabetes should provide approximately 15–30 g of carbohydrates per serving. In addition to carbohydrates, the cookies supplied dietary fiber and plant-based protein derived from pumpkin and red kidney beans, both of which have relatively low glycemic indices and have been reported to support glycemic control (Xu et al., 2022; Aprilia et al., 2022). The estimated nutrient composition of the intervention cookies was calculated using NutriSurvey software (2007) based on the product formulation.

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Participants were instructed to maintain their regular medication regimen and habitual dietary practices throughout the study period. Random blood glucose (RBG) levels were measured before (pre-test) and after (post-test) the intervention using a calibrated portable glucometer following standard operating procedures. The primary outcome of the study was the change in random blood glucose levels after seven days of intervention.

Data were analyzed using IBM SPSS Statistics version 25. Data normality was assessed using the Shapiro–Wilk test. Because the data were not normally distributed ($p < 0.05$), non-parametric statistical tests were applied. Within-group differences between pre-test and post-test measurements were analyzed using the Wilcoxon signed-rank test, whereas differences between the intervention and control groups were analyzed using the Mann–Whitney U test. Statistical significance was established at $p < 0.05$.

This study was approved by the Health Research Ethics Committee of Poltekkes Kemenkes Aceh (Ethical Approval No. DP.04.03/12.7/ 264 /2026), and written informed consent was obtained from all participants before data collection.

Results

A total of 48 participants completed the study, comprising 24 participants in the intervention group and 24 participants in the control group. Random blood glucose (RBG) levels were measured at baseline and after the 7-day intervention period to evaluate the effect of pumpkin (*Cucurbita moschata*) and red kidney bean (*Phaseolus vulgaris* L.) cookies on glycemic control. Overall, participants who received the functional cookies demonstrated a greater reduction in mean RBG levels than those in the control group. The changes in blood glucose levels before and after the intervention are presented in **Figure 1**, while the statistical analyses of within-group and between-group comparisons are summarized in **Tables 1 and 2**.

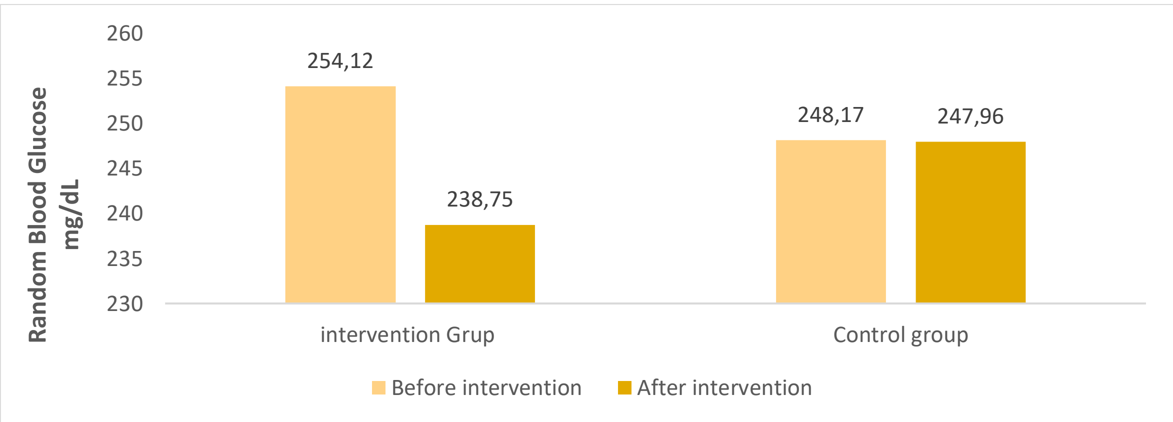

Figure 1 illustrates the mean random blood glucose (RBG) levels measured before and after the 7-day intervention in both study groups.

The intervention group demonstrated a noticeable reduction in mean RBG levels following the consumption of pumpkin (*Cucurbita moschata*) and red kidney bean (*Phaseolus vulgaris* L.) cookies. Mean RBG decreased from 254.12 mg/dL at baseline to 238.75 mg/dL after the intervention, representing a reduction of 15.37 mg/dL. In contrast, the control group showed almost no change in blood glucose levels during the observation period, with mean RBG decreasing only slightly from 248.17 mg/dL to 247.96 mg/dL, corresponding to a reduction of 0.21 mg/dL.

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Within-Group Comparison of Random Blood Glucose Levels

Table 1 presents the results of the Wilcoxon signed-rank test comparing pre-intervention and post-intervention RBG levels within each study group.

Table 1. Wilcoxon signed-rank test comparing random blood glucose levels before and after the intervention.

Group	Z	p-value
Intervention	-4.136	0.001
Control	-0.558	0.577

The Wilcoxon signed-rank test demonstrated a statistically significant reduction in random blood glucose levels in the intervention group (Z = −4.136, p = 0.001). Conversely, no statistically significant difference was observed between pre-test and post-test measurements in the control group (Z = −0.558, p = 0.577).

Between-Group Comparison of Changes in Random Blood Glucose Levels

To compare the magnitude of blood glucose changes between the intervention and control groups, the Mann–Whitney U test was performed using the difference between pre-test and post-test RBG values.

Table 2. Comparison of changes in random blood glucose levels between the intervention and control groups.

Group	n	Mean Rank	Sum of Ranks	Mann–Whitney U	Z	p-value
Intervention	24	34.48	827.50	48.500	-4.961	0.001
Control	24	14.52	348.50			

The Mann–Whitney U test revealed a statistically significant difference in the magnitude of blood glucose reduction between the two groups (U = 48.500, Z = −4.961, p = 0.001). Participants receiving pumpkin and red kidney bean cookies exhibited a significantly greater reduction in random blood glucose levels than those in the control group, indicating that the dietary intervention effectively improved short-term glycemic control among patients with type 2 diabetes mellitus.

Discussion

This study demonstrated that the administration of cookies formulated from pumpkin (*Cucurbita moschata*) and red kidney beans (*Phaseolus vulgaris* L.) for seven consecutive days significantly reduced random blood glucose levels among patients with type 2 diabetes mellitus. In contrast, no significant change was observed in the control group. These findings suggest that pumpkin–red kidney bean cookies have the potential to serve as a non-pharmacological dietary intervention to support glycemic control in individuals with type 2 diabetes mellitus. The observed hypoglycemic effect may be attributed to the combined nutritional properties of pumpkin and red kidney beans, particularly their high dietary fiber content, resistant starch, plant-based protein, and bioactive compounds such as flavonoids, phenolic compounds, and carotenoids. These components have been reported to delay gastric emptying, reduce intestinal glucose absorption, improve insulin sensitivity, and attenuate oxidative stress, thereby contributing to improved glycemic regulation (Reynolds et al., 2020; Aprilia et al., 2022).

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Dietary fiber plays an important role in slowing carbohydrate digestion and glucose absorption, leading to lower postprandial blood glucose concentrations. Furthermore, resistant starch and soluble fiber from legumes increase the production of short-chain fatty acids during colonic fermentation, which enhances insulin sensitivity and glucose metabolism. Red kidney beans also possess a low glycemic index and are rich in plant-based protein, making them a suitable ingredient for functional foods intended for individuals with diabetes (Xu et al., 2022; Reynolds et al., 2020).

Pumpkin is recognized as a functional food because it contains carotenoids, polyphenols, vitamins, and antioxidant compounds that contribute to improved glucose metabolism and protection against oxidative stress associated with diabetes. Experimental and clinical studies have suggested that pumpkin consumption may improve pancreatic β-cell function and reduce blood glucose concentrations, although the magnitude of these effects depends on the dosage, processing method, and duration of intervention (Aprilia et al., 2022).

The findings of the present study are consistent with those reported by Amelia and Junita (2025), who demonstrated that pumpkin-based functional foods significantly reduced blood glucose levels among patients with type 2 diabetes mellitus receiving outpatient care. Their study highlighted the potential of pumpkin as a locally available functional food that can complement dietary management of diabetes. Likewise, the incorporation of red kidney beans in the present study may have further enhanced the glycemic response because legumes are rich in dietary fiber, resistant starch, and slowly digestible carbohydrates that contribute to sustained glucose regulation (Xu et al., 2022).

These findings are further supported by a systematic review conducted by Reynolds et al. (2020), which concluded that higher dietary fiber intake significantly improves glycemic control and reduces cardiometabolic risk among adults with diabetes. Collectively, these findings reinforce the importance of utilizing locally available food resources, such as pumpkin and red kidney beans, in the development of functional foods as complementary nutritional therapy for type 2 diabetes mellitus.

This study has several limitations. The intervention period was relatively short (seven days), the sample size was limited, and potential confounding factors such as habitual dietary intake, physical activity, and medication adherence were not fully controlled. Therefore, future studies should employ larger sample sizes, longer intervention periods, and randomized controlled trial designs to provide more robust evidence regarding the effectiveness of pumpkin and red kidney bean cookies in improving glycemic control among patients with type 2 diabetes mellitus.

Conclusion

The administration of pumpkin (*Cucurbita moschata*) and red kidney bean (*Phaseolus vulgaris* L.) cookies for seven consecutive days significantly reduced random blood glucose levels among patients with type 2 diabetes mellitus in the working area of Kajhu Community Health Center. The findings suggest that cookies formulated from locally available pumpkin and red kidney beans may serve as a promising functional snack to support glycemic control as part of dietary management for individuals with type 2 diabetes mellitus. The beneficial effect is likely associated with the dietary fiber and other bioactive compounds naturally present in these ingredients, which may contribute to improved glucose regulation. Nevertheless, because this study involved a relatively small sample size and a short intervention period, further studies with larger populations, longer intervention durations, and

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randomized controlled trial designs are warranted to confirm the long-term effectiveness of this dietary intervention.

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