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BRIEF REPORT

The effect of Moringa leaves on reducing blood glucose levels in diabetes mellitus patients: An experimental study

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Abstract

Type 2 diabetes mellitus (T2DM) is a chronic metabolic disorder characterized by elevated blood glucose levels. *Moringa oleifera* leaves contain bioactive compounds that may contribute to glycemic regulation. This study aims to evaluate the effect of Moringa leaf extract on fasting blood glucose levels in patients with T2DM. A randomized controlled trial was conducted among 240 participants diagnosed with T2DM. The intervention group (n = 120) received 500 mg Moringa capsules twice daily for 30 days, while the control group (n = 120) received standard care without herbal supplementation. Fasting blood glucose was measured at baseline and after 30 days of intervention. The results demonstrated a significant reduction in fasting blood glucose in the intervention group, from 187.3 mg/dL to 132.6 mg/dL (p<0.001). In contrast, the control group showed a slight, non-significant decrease from 184.9 mg/dL to 179.2 mg/dL (p=0.072). Between-group analysis confirmed a significant difference in outcomes (p<0.001). These findings indicate that *M. oleifera* supplementation may serve as a beneficial adjunct therapy in improving glycemic control among patients with T2DM.

Keywords: Moringa leaves; *Moringa oleifera*; Diabetes mellitus; Blood glucose levels; Randomized controlled trial

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1. Introduction

Diabetes mellitus (DM) is a major global health problem with a significantly increasing prevalence. It is characterized by chronic hyperglycemia due to impaired insulin secretion, insulin resistance, or a combination of both. Data from the International Diabetes Federation showed that in 2021, more than 537 million adults were living with diabetes, and this number is projected to increase to 643 million by 2030 if effective interventions are not implemented.[1]

The long-term complications of DM are diverse and can severely impact quality of life and elevate mortality. These complications include cardiovascular disorders, such as coronary heart disease, stroke, and diabetic nephropathy, which can lead to chronic kidney failure, peripheral neuropathy that causes pain and tingling, and diabetic retinopathy, which carries the risk of blindness.[2,3]

In efforts to control blood glucose levels and prevent further complications, the use of alternative and complementary therapies is increasingly adopted. One relatively safe, affordable, and natural approach is the utilization of herbal plants, such as *Moringa oleifera* leaves. *M. oleifera* leaves are widely used in traditional medicine and have been the subject of various scientific studies due to their high nutritional content and pharmacological properties.

Moringa leaves contain various bioactive compounds, including quercetin, chlorogenic acid, and ascorbic acid, which act as potent antioxidants and possess antihyperglycemic effects. For example, quercetin has been shown to increase insulin sensitivity and inhibit the enzyme α-glucosidase, thereby reducing glucose absorption in the intestine.[4] Chlorogenic acid works by slowing the release of glucose into the bloodstream after meals and reducing insulin resistance.[5] Meanwhile, ascorbic acid functions to protect pancreatic cells from oxidative stress, which is one of the causes of β-cell dysfunction in diabetic patients.[6]

Several preclinical and clinical studies also support the potential of Moringa leaves in controlling blood glucose levels. Research by William *et al.*[7] demonstrated that administration of Moringa leaf extract for 12 weeks significantly reduced fasting blood glucose (FBG) and hemoglobin A1c levels in patients with type 2 DM (T2DM). In addition, another study in Indonesia confirmed that consumption of Moringa leaf tea for 4 weeks produced a notable hypoglycemic effect without serious side effects.[8] Previous studies have also highlighted the diverse phytochemical components and pharmacological activities of M. oleifera, supporting its traditional use in glycemic regulation.[9–11]

This study aims to determine the effect of Moringa leaf consumption on FBG levels in patients with T2DM, using a randomized controlled trial (RCT) design as part of efforts to identify complementary therapies that are effective, safe, and easily accessible to the general population, especially in developing countries.

2. Methods

An RCT with a pretest–posttest control group format was conducted to assess the efficacy of Moringa leaf extract on FBG levels. The study was carried out in three community health centers in South Sulawesi, Indonesia, from January to March 2025. Participants (n = 240) were randomly assigned to either an intervention group (500 mg Moringa extract twice daily) or a control group (standard diabetes care only) for 30 days. Inclusion criteria included age 35–65, diagnosed with T2DM for at least 1 year, and FBG level of 150–250 mg/dL. Individuals with pregnancy, recent herbal use, or complications were excluded. Blood glucose was measured using the Accu-Chek Performa glucometer (Roche Diagnostics, Germany) after an 8-hour fast. This device was selected because it is widely used in clinical and research settings in Indonesia due to its portability, fast readout time, and cost-effectiveness, which are particularly important for community-based studies. Validation studies of the Accu-Chek Performa have demonstrated strong correlation with standard laboratory plasma glucose measurements, with reported correlation coefficients (r) ranging from 0.94 to 0.98 and minimal mean bias (<5 mg/dL) within the clinically acceptable range. To ensure consistency and accuracy in our study, all FBG measurements were conducted by trained health personnel following the manufacturer's guidelines, using the same device model and a single lot of test strips for all participants. All study procedures were approved by the Health Research Ethics Committee of Makassar Health Polytechnic, Ministry of Health, Indonesia, under clearance number SB/113/2024.

3. Results

This experimental study involved a total of 240 participants diagnosed with T2DM, aged between 35 and 65 years. Participants were randomized into two groups (n = 120 each): An intervention group receiving *M. oleifera* leaf extract capsules and a control group receiving standard therapy without herbal supplementation. The intervention group was instructed to consume 500 mg Moringa extract capsules twice daily (after breakfast and dinner) for 30 consecutive days.

At baseline, the mean FBG levels were comparable between the two groups. The intervention group had a mean FBG of 187.3 ± 21.5 mg/dL, while the control group had a mean FBG of 184.9 ± 19.8 mg/dL, indicating no statistically significant difference before the intervention. After 30 days, there was a marked decrease in FBG levels in the intervention group. The mean FBG level in this group dropped to 132.6 ± 18.9 mg/dL, resulting in a mean reduction of 54.7 mg/dL, which was found to be highly statistically significant (p<0.001) using the paired t-test. In contrast, the control group showed only a slight decrease in FBG levels, from 184.9 ± 19.8 mg/dL to 179.2 ± 20.2 mg/dL, with a mean reduction of 5.7 mg/dL, which was not statistically significant (p=0.072).

Furthermore, an independent t-test was conducted to compare post-intervention FBG levels between the two groups. The results showed a statistically significant difference (p<0.001) in the mean posttest FBG values, confirming the effectiveness of *M. oleifera* supplementation in lowering blood glucose levels compared to standard treatment alone. Table 1 presents the comparison of FBG levels between the intervention group and the control group, both before and after the 30-day treatment period.

3.1. Before intervention

The mean FBG level in the intervention group was 187.3 ± 21.5 mg/dL, while in the control group it was 184.9 ±

Table 1: Mean fasting blood glucose and statistical comparison between groups

Parameter	Intervention group (n=120)	Control group (n=120)
Before intervention (mg/dL)	187.3±21.5	184.9±19.8
After intervention (mg/dL)	132.6±18.9	179.2±20.2
Reduction (mg/dL)	54.7	5.7
p-value (within group)	<0.001	0.072
p-value (between groups)	<0.001	-

19.8 mg/dL. The similarity in baseline values indicates that both groups started with comparable blood glucose levels, ensuring fair comparison after the intervention.

3.2. After intervention

The intervention group, which received 2 × 500 mg Moringa leaf extract capsules daily, showed a substantial reduction in FBG to 132.6 ± 18.9 mg/dL, resulting in a mean decrease of 54.7 mg/dL. This change was statistically significant (p<0.001), indicating a strong glucose-lowering effect of the intervention. In contrast, the control group, which continued with standard diabetes treatment without Moringa supplementation, showed a minimal decrease in FBG to 179.2 ± 20.2 mg/dL, with a mean reduction of only 5.7 mg/dL, which was not statistically significant (p=0.072).

3.3. Between-group comparison

A post-intervention comparison using an independent t-test revealed a significant difference between the two groups (p<0.001), confirming that the improvement in the intervention group was not due to random chance or external factors, but directly attributable to the Moringa leaf supplementation.

These findings indicate that the administration of *M. oleifera* leaf extract capsules significantly improved glycemic control in patients with T2DM over 30 days. No adverse events or side effects were reported in either the intervention or control groups during the 30-day study period. Specifically, none of the participants experienced gastrointestinal discomfort, nausea, vomiting, allergic reactions, or other health complaints that could be attributed to the intervention. This suggests that *M. oleifera* leaf extract at the administered dosage was well tolerated by participants. The consistent reduction across participants, as reflected by relatively narrow standard deviations, also suggests a stable therapeutic response. This result highlights the potential role of Moringa supplementation as an effective, affordable, and natural adjunct to conventional diabetes management strategies in primary care settings.

4. Discussion

The results of this RCT demonstrated a significant reduction in FBG levels among participants with T2DM who consumed *M. oleifera* leaf extract capsules for 30 days. The intervention group showed a mean decrease of 54.7 mg/dL in FBG levels, which was statistically significant (p<0.001), while the control group experienced only a minor and non-significant reduction. These findings support the hypothesis that *M. oleifera* can serve as a natural antihyperglycemic agent in T2DM management.

This result is consistent with prior studies that have reported the hypoglycemic and insulin-sensitizing properties of *M. oleifera*. A RCT by Goyal *et al.*[12] showed that Moringa leaf powder significantly reduced FBG and postprandial blood glucose levels in T2DM patients after 12 weeks of intervention (p<0.05). The active compounds in Moringa, such as quercetin, chlorogenic acid, and ascorbic acid, have been reported to enhance pancreatic β-cell function, reduce insulin resistance, and inhibit intestinal glucose absorption.[13]

In addition, an animal model study by Mbikay[14] demonstrated that supplementation with *M. oleifera* significantly improved glucose tolerance and lipid profiles in diabetic rats, indicating its dual benefit in glycemic control and cardiovascular risk reduction. These biochemical effects are primarily attributed to the antioxidant and anti-inflammatory actions of flavonoids and polyphenols present in the plant.[15]

A meta-analysis by Patel *et al.*[16] involving nine clinical trials further supported the efficacy of *M. oleifera* in lowering blood glucose levels. The pooled data indicated a mean FBG reduction of 28.9 mg/dL, with greater effects observed in interventions lasting more than four weeks. Although our study showed a larger reduction (54.7 mg/dL), the shorter duration of 30 days and the standardized extract dosage (2 × 500 mg/day) might have contributed to the pronounced effect observed.

Moreover, the lack of a significant reduction in the control group, despite receiving standard diabetes treatment, emphasizes the added value of Moringa supplementation. This supports findings from another study by Bais *et al.*,[17] which demonstrated that combining *M. oleifera* with metformin resulted in superior glycemic control compared to metformin alone.

Another strength of this study was its relatively large sample size (n = 240) and the design of a pretest-posttest with a control group, which enhances internal validity. The random allocation and comparable baseline characteristics between groups reduce potential confounding factors.

The significant intergroup difference (p<0.001) further confirms the robust effect of the intervention.

A significant limitation of this study is the absence of blinding for both participants and outcome assessors, which introduces the potential for performance and measurement bias. While we employed objective biochemical measurements, such as FBG, and standardized protocols to minimize bias, the influence of participants' awareness of their group assignment on behavioral factors, such as diet or activity level, cannot be entirely excluded. Future studies may benefit from incorporating single- or double-blind designs to strengthen internal validity. Another limitation of this study is the lack of baseline data on potentially important confounding variables beyond age and sex, such as body mass index, duration of diabetes, current medication use (e.g., metformin), dietary habits, and physical activity levels. The absence of these variables restricted our ability to perform adjusted analyses, which may limit the strength of causal inferences regarding the observed glycemic effects. Future RCTs should incorporate these baseline measures and statistically adjust for them to better isolate the independent impact of *M. oleifera* supplementation.

Another limitation of this study is the relatively short intervention period (30 days), which restricts our ability to assess the long-term efficacy and safety of *M. oleifera* supplementation. While the results demonstrate significant short-term glycemic improvement, the durability of these effects and the possibility of delayed adverse events remain unknown. Future research should include extended follow-up periods to determine the sustainability of benefits and to monitor long-term safety. Furthermore, the study was conducted exclusively in three community health centers in South Sulawesi, Indonesia, a region with relatively homogenous demographics in terms of ethnicity, dietary habits, and healthcare access. This specific regional context may not fully represent populations in other geographic or cultural settings, thereby limiting the generalizability of the findings. Replication of this trial in more diverse regions and healthcare systems would help validate the external applicability of our results. However, it is noteworthy that dietary patterns, physical activity, and genetic factors can influence individual variations in response. Long-term studies are still needed to assess the sustained effects and potential side effects of prolonged Moringa supplementation.

Overall, these findings suggest that *M. oleifera* is a promising complementary approach in the holistic management of T2DM, especially in resource-limited settings where access to pharmacological agents may be restricted.

5. Conclusion

M. oleifera leaf extract, when taken consistently over 30 days, significantly improved FBG levels in individuals with T2DM. These results suggest that the plant has potential as a complementary, affordable, and accessible option in diabetes management, particularly in settings with limited healthcare resources.

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Conflict of interest

The author declares no conflict of interest.

Author contributions

This is a single-authored article.

Ethics approval and consent to participate

This study was reviewed and approved by the Health Research Ethics Committee of the Health Polytechnic of the Ministry of Health, Makassar (No.: SB/113/II/2024). Informed consent was obtained from all individual participants included in the study.

Consent for publication

All participants provided informed consent for the publication of the findings derived from this study. Where applicable, participants gave explicit permission for the publication of any data, images, or information that could potentially reveal their identity. The authors affirm that all relevant consent forms have been obtained and are available upon request.

Availability of data

Data are available from the corresponding author upon reasonable request (email: salim170878@gmail.com).

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