

Original Research Article

Impact of *Moringa oleifera* on the post-prandial blood glucose level among adults in Rawalpindi, Pakistan

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ABSTRACT

Background: *Moringa oleifera* (MO) has been used in the treatment of the Diabetes Mellitus (DM) all over the world. However, studies in Pakistan which show impact of MO on the blood glucose are lacking. This study was aimed to assess the impact of the MO leaf powder capsules on post-prandial blood glucose levels in diabetic and non-diabetic participants.

Methods: This pilot study was conducted in a health care center, Rawalpindi, Pakistan among 14 diabetic and 14 non-diabetic participants for one year from January 2021 to December 2022. All participants were asked to fast for 12 hours on two occasions and each time their blood glucose levels were assessed via glucometer after giving bread. On first visit without MO capsules and on next visit with MO capsules. Data analysis was done by applying descriptive and paired t-test via SPSS version 25.

Results: The mean values for study population of age, fasting blood glucose level, and post-prandial blood glucose level without giving MO capsules were, 51.50 with SD±5.28 year, 136.94 with SD±39.64 mg/dL, and 306.31 SD±151.35 mg/dL respectively. After 90 minutes of Intake of MO leaf powder capsule, the reduction in post-prandial blood glucose level in diabetic patients was significant ($p=0.03$), however, in non-diabetic healthy participants, it was statistically insignificant ($p=0.08$). No side-effects of MO were observed in any participant.

Conclusions: In short, this study showed that *Moringa oleifera* ingestion decreases post-prandial blood glucose level significantly among diabetic, while not in non-diabetic. Moreover, intake of MO has no side effects.

Keywords: Blood glucose, Impact, *Moringa oleifera*, Post-prandial, Rawalpindi

INTRODUCTION

Diabetes mellitus (DM) is one of the most of common endocrine disorders, in which insulin deficiency or insulin resistance in body leads to raised blood glucose level. It is estimated that more than 415 million people around the world have been affected by the DM and it is predicted

that this number would be stretched to 642 million till the end of 2040. It is claimed by WHO (World Health Organization) that approximately 10% (12.9 million) of Pakistani population are suffering from diabetics and from these only 9.4 million people are diagnosed whereas, 3.5 million people are undiagnosed. Moreover, a large number of people (38 million) in Pakistan have

prediabetes and more of these victims are women. In Pakistan, every year more or less 120,000 people die because of DM linked complications.^{1,2}

Treatment of DM is generally complicated and expensive. Several strategies are present for the management of DM world-wide and these modalities could be diet modification, exercise, oral antidiabetic drugs and inulin.^{3,4} DM treatment through antidiabetic drugs and insulin is very costly and it leads to non-compliance among the non-affording patients. It is estimated at Gabriel Touré University Hospital in a survey on diabetic patients that 71% of patients had a monthly salary below US\$100, however, the mean treatment costs per year for diabetic patients were US\$1169.⁵ This finding about the cost of diabetic patient treatment was also backed by a study which noted that total per year healthcare linked expenses for diabetic patients were about \$1127.⁶

Several herbal medicines have been used for the treatment of diabetes mellitus because of low cost all over the world. One of those herbs is *Moringa oleifera* (MO). MO commonly known as the “drumstick tree” as it has large seed-pods. It is usually present in the western sub-Himalayan regions of India, Pakistan, Bangladesh and Afghanistan, however, nowadays, because of its high demand it has been planted for food and medicine in tropical Asia and sub-Saharan Africa.⁷ In several parts of the world, MO has been used in the treatment of different diseases other than diabetes mellitus like diarrhea, infections, hypertension, hyperthyroidism, and cancers.^{8,9} In Thailand, it is used as daily food ingredient.¹⁰ MO leaves have protein, essential amino acids, iron, copper, calcium, Vitamin C and carotenoids that's why they have been used as a nutritional supplement for malnutrition of children, lactating females, and people who suffered from osteoporosis.¹¹

Previous clinical trial studies about the influence of MO leaf powder capsules on the post-prandial blood glucose level had presented diversity in their results. Several clinical trials manifested that the intake MO capsule leads to the reduction in post-prandial blood glucose level among diabetic.^{12,13} While, clinical trials also exit in the literature which suggested that MO capsules haven't role in the improvement of post-prandial blood glucose level among diabetic.¹⁰

Although, the clinical trials on the impact of MO on blood glucose levels are present world-wide with conflicting results regarding the impact of MO leaf powder capsule on post-prandial blood glucose level, however, these trials are limited in Pakistan.

Aim

this study aims to determine the impact of MO on post-prandial blood glucose level among diabetic and non-diabetic participants in Rawalpindi, Pakistan.

METHODS

Study design and study population

This pilot study was conducted in a health care center, Rawalpindi, Pakistan among 28 participants for one year from January 2021 to December 2022. Before the start of this clinical trial study ethical approval was obtained from. Informed consent was also waived from all participants before the data collection. Objectives of the study were explained to all participants.

Inclusion criteria

28 adults (With age range between 40 to 60 years) were enrolled in the study through inclusion and exclusion criteria. 14 participants were diabetic while 14 participants were non-diabetic. Only those diabetic patients who had diet and exercise-controlled diabetes mellitus type 2 were included in the study.

Exclusion criteria

Whereas diabetic patients were excluded from the study if they had any cardiac, respiratory, renal, or liver disease, if they were pregnant, if their fasting blood glucose level was less than 126 mg/dL (7.0 mmol/L), if their post-prandial blood glucose level was less than 200 mg/Dl (11.1 mmol/l), or if they had allergy to moringa leaf powder. Similarly, only those non-diabetic participants were included who were willing to take part in the study, while non-diabetic participants who had any cardiac, renal, liver, or respiratory disease; or had any allergy to moringa powder were excluded from the study.

Study procedure and data collection

Data was recorded on a self-designed proforma. Patients were asked to come on two occasions after first meeting with them, almost 10 days apart. This proforma was composed of two parts. On first part of proforma socio-demographic characteristics of the study population such as gender (male or female) and age were documented. It was filled during very first meeting with participants. Blood glucose levels either baseline or after giving moringa were noted on the second part of proforma. When patients came first time after 10 days with the fasting of 12 hours, fasting blood glucose level and after taking 4 slices (120 grams) of bread/post-prandial blood glucose levels after 90 minutes were noted without giving MO leaf powder capsules. On second occasion after another 10 days when patients came back with fasting of 12 hours, first their fasting blood glucose level was noted. After that they were allowed to eat 4 slices (120 grams) of bread and then 30 minutes later they were given 1 gram capsule of moringa with simple water. Their blood glucose levels were noted after 90 minutes after taking bread. Standard blood glucometer was used to determine blood glucose level via finger prick method. Pakistan made capsules of *moringa oleifera* were used. They were

also asked to inform about any symptoms if they get after taking moringa capsules.

Statistical analysis

After data collection, data analysis was entered into Statistical Package for the Social Sciences (SPSS) software version 25 (Armonk, NY: IBM Corp.). Then data analysis was done by applying descriptive and paired t-test. Paired t-test was applied to determine the significant difference between the means of postprandial blood glucose levels before and after giving MO capsule. This difference in the blood glucose levels before and after taking moringa capsule of diabetic and non-diabetic participants were assessed one by one by paired t-test. The frequency and percentage of qualitative data were estimated, while means of quantitative data were measured. P value less than 0.05 was set as statistically significant.

RESULTS

Out of 28 participants 19 (67.86%) were females while 09 (32.14%) were males. The mean age for the study population was 51.50 years with standard deviation (SD) of ± 5.28 . The overall means of fasting blood glucose level and post-prandial blood glucose level that were noted during their first visit without giving moringa capsule, after 10 days were 136.94 mg/dl (7.6 mmol/l) with SD of 39.64 mg/dl (2.2 mmol/l) and 306.31 mg/dl (17.0 mmol/l) with SD of 151.35 mg/dl (8.4 mmol/l).

Table 1 describes that diabetic group has older population with higher number of females. Fasting and post-prandial blood glucose levels were also higher among diabetic group.

Table 1: Baseline features of the participants.

Variables	Diabetic (n=14)	Non-diabetic (n=14)
Mean of age in years (SD)	56.78 (4.23)	46.22 (1.05)
Number of females (%)	10 (71.42%)	9 (64.28%)
Number of males (%)	4 (28.58%)	5 (35.72%)
Mean of fasting blood glucose level mg/dL (SD)	176.58 (24.60)	97.30 (15.04)
Mean of post-prandial blood glucose level mg/dL (SD)	457.66 (111.69)	154.96 (39.66)

Table 2: Comparison of post-prandial blood glucose level of diabetic patients via paired t-test.

Variable (diabetic group)	Fasting blood glucose level (after 12 hours fasting) mg/dL (SD)	Postprandial blood glucose level (after 90 minutes) mg/dL (SD)
On 1 st occasion without moringa capsule	176.58 (24.60)	457.66 (111.69)
On 2 nd occasion with moringa capsule	180.29 (32.09)	421.62 (75.65)
Paired t-test (p-value)	0.12	0.03

Table 3: Comparison of post-prandial blood glucose level of non-diabetic participants via paired t-test.

Variable (non-diabetic group)	Fasting blood glucose level (after 12 hours fasting) mg/dL (SD)	Postprandial blood glucose level (after 90 minutes) mg/dL (SD)
On 1 st occasion without moringa capsule	97.30 (15.04)	154.96 (39.66)
On 2 nd occasion with moringa capsule	99.12 (14.18)	147.80 (32.50)
Paired t-test (p-value)	0.20	0.08

Table manifests 2 that there was no significant difference between fasting blood glucose levels which were noted on two different occasions before taking moringa capsules. It also shows that the difference between the post-prandial blood glucose levels before and after taking moringa capsules was statistically significant.

Table 3 explains that there was no significant difference between fasting blood glucose levels which were noted on two different moments before taking moringa capsules. Furthermore, it elaborates that the difference between the post-prandial blood glucose levels before and

after taking moringa capsules was also statistically insignificant.

DISCUSSION

This study has demonstrated the effect of the Moringa oleifera leaf powder capsule on the post-prandial blood glucose among diabetic and non-diabetic participants. Among diabetic patients ingestion of the 1 gram MO leaf powder capsule had reduced the post-prandial blood glucose level significantly ($p=0.03$), whereas, among the non-diabetic volunteer participants the reduction in the

post-prandial blood glucose level was statistically insignificant ($p=0.08$).

Many clinical trials have shown that the intake of MO leaf improved blood glucose levels. A clinical trial determined HbA1c and post-prandial blood glucose levels after three months in 30 patients with type 2 diabetes who took a Moringa leaf powder capsule after breakfast and dinner daily, along with sulphonylurea, in comparison to 30 control patients without Moringa.¹² The experimental category of patients had a notable decrease of HbA1c level from 7.8% to 7.4% and in postprandial blood glucose level, while there was no significant difference in the control category of the patients. In another clinical trial on 17 diabetic patients, it was noted that 20 grams of dried Moringa leaf powder significantly decreased post-prandial glucose levels in diabetic patients after eating a usual meal.¹⁴ A recent clinical trial also showed that MO supplementation leads to favorable changes in glycaemia blood indicators in comparison to placebo among prediabetes. This study has recommended that MO plant might use as a natural anti-hyperglycemic agent, before any pharmacological treatment.¹³

Some clinical trial also noted that MO leaf capsules do not bring any betterment in the postprandial blood glucose level among diabetic. A prospective randomized placebo controlled clinical trial study that was conducted among therapy-naïve type 2 diabetes mellitus (T2DM) also supported the idea that MO leaf capsule do not bring any significant change in the post-prandial blood glucose level among diabetic patients.¹⁰

Divergence in the results linked with the influence MO capsule on post-prandial among diabetic patients could be due to several reasons such as use of raw material of MO in some studies while refined form of MO in others, use of various doses of MO in different studies, and similarly distinct stages of DM in diabetic population of clinical trial studies could also be a reason of their distinguished conclusions about MO capsule and post-prandial blood glucose relationship.

The blood glucose lowering effects of MO leaf capsules have been assumed to be linked with reduced intestinal glucose uptake, delaying gastric emptying time by fiber in MO leaf, and by increasing insulin secretion.^{15,16} MO leaf had also an effect on postprandial plasma glucose by their three important bioactive phytochemicals such as quercetin, chlorogenic acid, and moringinine. These chemicals improve pos-prandial blood glucose level by decreasing insulin resistance, inhibiting glucose-6-phosphate translocase in liver which causes a decrease in hepatic gluconeogenesis and glycogenolysis, and by refinement in the glucose tolerance test.^{10,17}

No side effects were noted among participants either among diabetic or non-diabetic participants in current study. Another study also showed no side among its participants after the intake of MO leaf powder capsules.⁷

The limitations of current study were a short duration and small sample of the study. Therefore, further research work is needed to assess either MO leaf capsule also reduce HBA1c level and diabetes type 2 related complications as well with long term use of it or not. As this clinical trial was among small groups of participants with low dose of MO, therefore, more clinical trials with larger sample size with different and maximum dose of MO without toxicity should be conducted. This kind of clinical trials would further support the use of MO leaf capsule in the management of blood glucose level in diabetic and it would be cost-effective as well. Ultimately, the compliance would be better among diabetic and less complications and diabetes related mortality.

CONCLUSION

This study has suggested that Moringa oleifera leaf powder capsule reduces the post-prandial blood glucose level in diabetic patients significantly, while the reduction in the post-prandial blood glucose level in non-diabetic participants was statistically insignificant. No adverse effect was noted among the participants. It also recommends that Moringa oleifera could be used as possible antidiabetic agent.

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Conflict of interest: None declared

Ethical approval: The study was approved by the Institutional Ethics Committee

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