Effect of *Moringa oleifera* Leaf Supplementation on Glycemic and Hemodynamic Parameters in Type 2 Diabetes Mellitus: A Randomised Controlled Trial

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Article

Effect of *Moringa oleifera* Leaf Supplementation on Glycemic and Hemodynamic Parameters in Type 2 Diabetes Mellitus: A Randomised Controlled Trial

Running Title: Effect of Moringa leaves on T2DM

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Abstract

Background: Type 2 diabetes mellitus (T2DM) is a global health concern associated with hyperglycemia and cardiovascular risk. Despite pharmacological therapies, side effects and non-compliance remain challenges. Moringa oleifera (MO), rich in bioactive phytochemicals, shows promise as a complementary approach. Objective: To evaluate the effect of Moringa oleifera leaf juice supplementation, in addition to standard therapy, on random blood glucose (RBS) and cardiovascular parameters in patients with T2DM. Methods: A prospective, randomised controlled trial was conducted among 107 T2DM patients. Group 1 (n=53) received fresh MO leaf juice plus standard therapy, while Group 2 (n=54) received standard therapy alone. RBS, systolic blood pressure (SBP), diastolic blood pressure (DBP), and mean arterial pressure (MAP) were measured at baseline, 30 min, and 60 min. Non-parametric statistical tests were applied. Results: The intervention group showed significant reductions in RBS from baseline to 30 and 60 minutes compared to the control group ($p = 0.035$ and $p < 0.001$). SBP and MAP also improved significantly, while DBP changes were modest. Conclusions: Moringa oleifera juice supplementation alongside conventional therapy significantly improved glycemic control and cardiovascular parameters. Its phytochemical profile and safety suggest potential as a dietary adjunct for T2DM management.

Keywords: type 2 diabetes mellitus; Moringa oleifera; random blood glucose; blood pressure; complementary medicine; randomised trial

1. Introduction

Type 2 diabetes mellitus (T2DM) is a chronic metabolic disorder characterised by impaired insulin secretion and reduced tissue responsiveness to insulin. It represents the predominant form of diabetes worldwide, contributing substantially to morbidity, mortality, and healthcare costs [1,2]. In India, the prevalence of T2DM continues to rise due to lifestyle changes and urbanisation [3–5].

Standard management of T2DM includes lifestyle modifications, oral hypoglycemic agents, and insulin therapy when indicated [6–9]. However, challenges such as medication adherence, cost, and adverse effects have prompted interest in complementary nutritional strategies that may support glycemic control [10,11].

Moringa oleifera, commonly known as the drumstick tree, has been used in traditional medicine for its nutritional and therapeutic properties [12–15]. Its leaves are rich in flavonoids, polyphenols, and isothiocyanates, which exhibit antioxidant, anti-inflammatory, and potential antidiabetic effects [16–19]. Preclinical studies suggest that *Moringa* may modulate glucose metabolism, improve insulin sensitivity, and reduce lipid levels [17–22]. Emerging clinical evidence also indicates potential benefits in reducing blood glucose and cardiovascular risk factors [18,23–27].

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Given these properties, evaluating the efficacy of *Moringa oleifera* leaf supplementation in individuals with T2DM is of clinical relevance. The present randomised controlled trial was conducted to assess its effects on random blood sugar (RBS) and blood pressure parameters [24,25].

2. Materials and Methods

2.1. Study Design and Participants

A randomised controlled trial was conducted at Subharti University, Meerut. 107 T2DM patients aged 25–75 years, with ≥1 year duration of diabetes, were included. Exclusion criteria: pregnancy, lactation, renal disease, autoimmune conditions, and insulin therapy.

2.2. Intervention

Group 1 received fresh Moringa oleifera juice (50 g leaves + 100 mL water) plus standard therapy. Group 2 received standard therapy only.

2.3. Outcomes

Primary: Random blood glucose (RBS). Secondary: SBP, DBP, MAP.

2.4. Statistical Analysis

SPSS was used. Mann–Whitney U and Wilcoxon signed-rank tests were applied. Significance at $p<0.05$.

3. Results

A total of 107 patients were randomised. 53 were analysed in the intervention group and 54 were analysed in the control group. No significant differences were observed in baseline age or gender distribution. RBS was significantly reduced in the intervention group compared to the control at 30 min ($p = 0.035$) and 60 min ($p < 0.001$). SBP and MAP improved significantly in the intervention group ($p<0.05$). DBP showed a modest reduction.

4. Discussion

This randomised trial demonstrated that supplementation with Moringa oleifera leaves led to improvements in glycemic status and modest reductions in blood pressure among patients with type 2 diabetes mellitus (T2DM). Participants in the intervention group experienced a decline in RBS compared with the control group, consistent with prior reports of the plant's hypoglycemic activity [18,24,25].

The observed effects may be attributed to bioactive phytochemicals in *Moringa* leaves, particularly quercetin and chlorogenic acid, which enhance insulin action and reduce postprandial glucose excursions [16,19,22,25]. The modest antihypertensive effect aligns with mechanisms involving vasodilation and improved endothelial function [23,30].

These findings support earlier clinical trials documenting glucose-lowering effects of *Moringa oleifera* supplementation in diabetic and prediabetic populations [18,23–27]. Differences in dosage, formulation, and duration across studies may explain variability in outcomes. In the present study, improvements were evident after 30 days, suggesting early adjunctive benefits when combined with standard care [24,25].

Strengths of the trial include its randomised design, objective measurement of biochemical and hemodynamic parameters, and use of a standardised supplement.

Limitations include a relatively small sample size, short intervention period, and reliance on RBS instead of fasting glucose or HbA1c as the primary endpoint, which may limit generalizability and underestimate long-term effects.

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Moringa oleifera leaf supplementation demonstrated favourable short-term effects on glycemic control and blood pressure in individuals with T2DM. Further research with larger cohorts, longer duration, and standardised preparations is warranted to establish its clinical utility and mechanism of action.

5. Conclusions

Moringa oleifera juice improved glycemic and cardiovascular parameters in T2DM patients. It may serve as a safe, affordable, and culturally acceptable adjunct to standard care.

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Informed Consent Statement: Written informed consent was obtained from all subjects involved in the study.

Data Availability Statement: The data presented in this study are available on request from the corresponding author.

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Conflicts of Interest: The authors declare no conflict of interest.

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