

Hypoglycemic Effects of Fenugreek Seeds in Patients with Type 2 Diabetes Mellitus: A Prospective Interventional Study

¹Ragini Bhardwaj, ²Dr. Prashant Wadagbalkar, ³Rahat Khan Warsi

^{1,3}Research Scholar, Department of Pharmacology, Index Medical College, Hospital & Research Centre, Malwanchal University, Indore, India

²Research Supervisor & Professor, Department of Pharmacology, Index Medical College, Hospital & Research Centre, Malwanchal University, Indore, India

Corresponding Author

Ragini Bhardwaj

raginibhardwaj13@gmail.com

ABSTRACT

Background: Type 2 diabetes mellitus (T2DM) is a major metabolic disorder characterized by chronic hyperglycemia resulting from impaired insulin secretion and insulin resistance. Despite the availability of effective pharmacological therapies, many patients continue to experience suboptimal glycemic control. Fenugreek (*Trigonella foenum-graecum*), a traditional medicinal plant, has gained attention due to its potential hypoglycemic properties.

Objective: To evaluate the effect of fenugreek seed supplementation on glycemic parameters in patients with type 2 diabetes mellitus.

Materials and Methods: A prospective interventional study was conducted among 80 patients with T2DM attending the outpatient department of a tertiary care hospital. Participants received fenugreek seed powder 10 g daily in addition to their standard antidiabetic treatment for 12 weeks. Fasting blood glucose (FBG), postprandial blood glucose (PPBG), and glycated hemoglobin (HbA1c) were assessed at baseline and at the end of the intervention. Statistical analysis was performed using paired t-test, with $p < 0.05$ considered statistically significant.

Results: The mean age of participants was 54.8 ± 8.6 years. After 12 weeks of fenugreek supplementation, significant reductions were observed in mean FBG (168.2 ± 28.4 mg/dL to 138.6 ± 24.7 mg/dL), PPBG (248.5 ± 39.2 mg/dL to 204.3 ± 33.5 mg/dL), and HbA1c ($8.46 \pm 0.82\%$ to $7.62 \pm 0.71\%$) ($p < 0.001$ for all comparisons).

Conclusion: Fenugreek seed supplementation significantly improved glycemic control in patients with type 2 diabetes mellitus. The findings suggest that fenugreek may serve as a useful adjunct to conventional antidiabetic therapy.

Keywords: Fenugreek, *Trigonella foenum-graecum*, Type 2 diabetes mellitus, Hypoglycemic effect, Fasting blood glucose, HbA1c, Glycemic control

INTRODUCTION

Type 2 diabetes mellitus (T2DM) is one of the most prevalent chronic metabolic disorders worldwide and represents a major public health challenge. The disease is characterized by persistent hyperglycemia resulting from insulin resistance and progressive β -cell dysfunction. The global burden of diabetes continues to increase, leading to significant morbidity, mortality, and healthcare expenditure.[1]

Although conventional antidiabetic medications effectively control blood glucose levels, long-term treatment is often associated with adverse effects, high costs, and issues related to adherence. Consequently, there has been increasing interest in complementary and alternative therapies that may enhance glycemic control and improve overall metabolic health.[2]

Fenugreek (*Trigonella foenum-graecum*) is a medicinal plant widely used in traditional systems of medicine, particularly in South Asia and the Middle East. The seeds contain soluble fiber, galactomannan, saponins, trigonelline, and the amino acid 4-hydroxyisoleucine, which are believed to contribute to its antidiabetic effects. These bioactive constituents may delay carbohydrate absorption, improve insulin sensitivity, and stimulate insulin secretion.[3]

Several experimental and clinical studies have reported favorable effects of fenugreek on fasting blood glucose, postprandial glucose levels, and glycated hemoglobin among individuals with diabetes. Recent systematic reviews and meta-analyses have further suggested that fenugreek supplementation may significantly improve glycemic parameters in patients with T2DM and prediabetes.[4,5]

In addition to glycemic benefits, fenugreek has been shown to exert positive effects on lipid metabolism and insulin resistance, thereby potentially reducing cardiovascular risk factors commonly associated with diabetes.[2]

Despite encouraging evidence, variability in study design, dosage, and duration of supplementation has resulted in inconsistent findings. Therefore, further clinical studies are required to evaluate the efficacy of fenugreek supplementation in routine diabetic care.[4]

The present study was undertaken to assess the hypoglycemic effects of fenugreek seeds in patients with type 2 diabetes mellitus receiving standard antidiabetic therapy.

MATERIALS AND METHODS

This prospective interventional study was conducted in the Department of General Medicine of a tertiary care teaching hospital over a period of six months. Patients diagnosed with type 2 diabetes mellitus attending the outpatient department were screened for eligibility based on predefined inclusion and exclusion criteria. A total of 80 eligible participants were enrolled in the study. All participants received fenugreek seed powder at a dose of 10 g daily (5 g twice daily before meals) in addition to their ongoing antidiabetic therapy for a duration of 12 weeks. Baseline demographic and clinical data were recorded, and glycemic parameters were assessed before and after the intervention to evaluate the hypoglycemic effects of fenugreek supplementation.

Data Collection

Detailed demographic and clinical information was recorded at baseline. Laboratory investigations included:

- Fasting Blood Glucose (FBG)
- Postprandial Blood Glucose (PPBG)
- Glycated Hemoglobin (HbA1c)

Measurements were performed at baseline and after completion of 12 weeks of supplementation.

Inclusion Criteria

- Patients aged 30–70 years.
- Diagnosed cases of type 2 diabetes mellitus.
- HbA1c between 7% and 10%.
- Stable antidiabetic therapy for at least three months.
- Willingness to provide written informed consent.

Exclusion Criteria

- Type 1 diabetes mellitus.
- Pregnancy or lactation.
- Severe renal impairment.
- Chronic liver disease.
- Acute diabetic complications.
- Known allergy to fenugreek.
- Patients receiving herbal antidiabetic supplements.

- Serious systemic illness affecting study participation.

Ethical Considerations

The study protocol was approved by the Institutional Ethics Committee. Written informed consent was obtained from all participants prior to enrollment.

Statistical Analysis

Data were entered into Microsoft Excel and analyzed using SPSS version 25.0. Continuous variables were expressed as mean $\pm$ standard deviation, while categorical variables were expressed as frequencies and percentages. Comparison between baseline and post-intervention values was performed using paired Student's t-test. A p-value less than 0.05 was considered statistically significant.

RESULTS

A total of 80 patients with type 2 diabetes mellitus completed the study and were included in the final analysis. The demographic characteristics, baseline clinical parameters, and changes in glycemic indices following 12 weeks of fenugreek supplementation were evaluated. The findings are presented in the following tables.

Table 1: Demographic Characteristics of Study Participants (n = 80)

Variable		Number	Percentage
Age Group (Years)	30-40	10	12.5%
	41-50	24	30%
	51-60	31	38.8%
	>60	15	18.7%
Gender	Male	46	57.5%
	Female	34	42.5%
Duration of Diabetes	<5 years	28	35%
	5–10 years	37	46.3%
	>10 years	15	18.7%

The majority of participants belonged to the 51–60 years age group (38.8%). Males constituted 57.5% of the study population. Nearly half of the patients (46.3%) had diabetes for 5–10 years.

Table 2: Baseline Clinical Characteristics of Participants

Parameter	Mean $\pm$ SD
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Age (years)	54.8 ± 8.6
Body Mass Index (kg/m ²)	27.4 ± 3.2
Fasting Blood Glucose (mg/dL)	168.2 ± 28.4
Postprandial Blood Glucose (mg/dL)	248.5 ± 39.2
HbA1c (%)	8.46 ± 0.82

At baseline, participants exhibited poor glycemic control, as reflected by elevated fasting and postprandial blood glucose levels and a mean HbA1c of 8.46%.

Table 3: Comparison of Glycemic Parameters Before and After Fenugreek Supplementation

Parameter	Baseline Mean ± SD	12 Weeks Mean ± SD	Mean Difference	p-value
FBG (mg/dL)	168.2 ± 28.4	138.6 ± 24.7	-29.6	<0.001
PPBG (mg/dL)	248.5 ± 39.2	204.3 ± 33.5	-44.2	<0.001
HbA1c (%)	8.46 ± 0.82	7.62 ± 0.71	-0.84	<0.001

A statistically significant reduction was observed in fasting blood glucose, postprandial blood glucose, and HbA1c after 12 weeks of fenugreek supplementation ($p < 0.001$).

Table 4: Distribution of Participants According to HbA1c Levels Before and After Intervention

HbA1c Category (%)	Baseline n (%)	After 12 Weeks n (%)
<7.0	8 (10.0)	24 (30.0)
7.0–8.0	25 (31.3)	39 (48.7)
>8.0	47 (58.7)	17 (21.3)

Following supplementation, the proportion of patients with HbA1c above 8% decreased substantially from 58.7% to 21.3%, indicating improved glycemic control.

Table 5: Adverse Events Reported During Study Period

Adverse Event	Number	Percentage
Mild gastrointestinal discomfort	6	7.5%
Bloating	4	5.0%
Nausea	2	2.5%

No adverse events	68	85.0%
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Fenugreek supplementation was generally well tolerated. Most participants (85.0%) reported no adverse effects, while the observed side effects were mild and self-limiting.

DISCUSSION

The present study demonstrated that fenugreek seed supplementation significantly improved glycemic parameters in patients with type 2 diabetes mellitus. A substantial reduction was observed in fasting blood glucose, postprandial blood glucose, and HbA1c levels after 12 weeks of intervention. These findings support the growing body of evidence suggesting that herbal adjunctive therapies may contribute to improved glycemic control and insulin sensitivity in individuals with type 2 diabetes mellitus.[6]

The hypoglycemic effect of fenugreek is believed to result from its rich content of soluble fiber, galactomannan, trigonelline, and 4-hydroxyisoleucine. These bioactive constituents may delay gastric emptying, reduce intestinal glucose absorption, enhance insulin secretion, and improve peripheral insulin sensitivity. Recent mechanistic studies have further highlighted the role of trigonelline and related phytochemicals in regulating glucose homeostasis and metabolic pathways associated with diabetes.[7]

In the present study, fasting blood glucose decreased significantly from 168.2 ± 28.4 mg/dL to 138.6 ± 24.7 mg/dL following 12 weeks of fenugreek supplementation. Similar findings were reported by Ranade and Mudgalkar, who demonstrated that the addition of fenugreek seeds to the daily diet significantly reduced blood glucose levels among patients with type 2 diabetes mellitus.[8]

Postprandial blood glucose levels also showed significant improvement after the intervention. This observation is consistent with recent evidence indicating that fenugreek supplementation improves glucose metabolism, enhances insulin sensitivity, and contributes to better glycemic control in patients with diabetes mellitus.[9] The improvement in postprandial glycemia observed in the present study may be attributed to delayed carbohydrate absorption and enhanced insulin action.

A clinically meaningful reduction in HbA1c was observed in the current study. Since HbA1c reflects average blood glucose concentrations over the preceding two to three months, the decline indicates sustained improvement in long-term glycemic control. Comparable reductions in

HbA1c and other glycemic parameters have been reported in the systematic review and meta-analysis conducted by Vajdi et al., which demonstrated favorable metabolic effects of fenugreek supplementation in patients with type 2 diabetes mellitus.[4]

The present findings are further supported by Hota et al., who demonstrated that supplementation with a standardized fenugreek seed extract significantly improved glycemic parameters in patients with type 2 diabetes mellitus.[10] Improved insulin responsiveness and enhanced glucose utilization may contribute to the beneficial effects observed with fenugreek supplementation.

Fenugreek supplementation was generally well tolerated in the present study. Only mild gastrointestinal adverse effects were reported, and no serious complications occurred during the study period. Similar safety findings were reported by Verma et al. in a multicenter clinical study evaluating a novel fenugreek seed extract in patients with type 2 diabetes mellitus.[11]

The study has certain limitations. The relatively small sample size, single-center design, and lack of a placebo-controlled comparison group may limit the generalizability of the findings. Furthermore, the duration of follow-up was limited to 12 weeks. Therefore, larger multicentric randomized controlled trials are required to establish the long-term efficacy, safety, and optimal dosage of fenugreek supplementation in patients with type 2 diabetes mellitus.[1]

Overall, the findings of the present study suggest that fenugreek seed supplementation may contribute significantly to improved glycemic control in patients with type 2 diabetes mellitus. The observed reductions in fasting blood glucose, postprandial blood glucose, and HbA1c support its potential role as a safe, economical, and effective adjunct to standard antidiabetic therapy. Further well-designed clinical trials are warranted to strengthen the existing evidence and guide clinical practice.

CONCLUSION

Fenugreek seed supplementation for 12 weeks resulted in significant reductions in fasting blood glucose, postprandial blood glucose, and HbA1c levels among patients with type 2 diabetes mellitus. The intervention was well tolerated and associated with minimal adverse effects. These findings suggest that fenugreek may serve as a safe, economical, and effective adjunct to conventional antidiabetic treatment. Further large-scale randomized controlled studies are

warranted to validate these results and establish evidence-based recommendations for clinical practice.

REFERENCES

1. Kim J, Noh W, Kim A, Choi Y, Kim YS. The Effect of Fenugreek in Type 2 Diabetes and Prediabetes: A Systematic Review and Meta-Analysis of Randomized Controlled Trials. *Int J Mol Sci*. 2023 Sep 12;24(18):13999. doi: 10.3390/ijms241813999.
2. Haxhiraj M, White K, Terry C. The Role of Fenugreek in the Management of Type 2 Diabetes. *Int J Mol Sci*. 2024 Jun 26;25(13):6987. doi: 10.3390/ijms25136987.
3. Shabil M, Bushi G, Bodige PK, Maradi PS, Patra BP, Padhi BK, Khubchandani J. Effect of Fenugreek on Hyperglycemia: A Systematic Review and Meta-Analysis. *Medicina (Kaunas)*. 2023 Jan 27;59(2):248. doi: 10.3390/medicina59020248.
4. Vajdi M, Noshadi N, Bonyadian A, Golpour-Hamedani S, Alipour B, Pourteymour Fard Tabrizi F, Abbasalizad-Farhangi M, Askari G. Therapeutic effect of fenugreek supplementation on type 2 diabetes mellitus: A systematic review and meta-analysis of clinical trials. *Heliyon*. 2024 Aug 22;10(17):e36649. doi: 10.1016/j.heliyon.2024.e36649.
5. Shakil S, Akhtar SE, Ali A, Antony M, Antony I, Mansour E, Khawar Farooqui S, Akbar A, Alazazzi H, Alsufyani R, Alsufyani M, Alawadhi R, Ramtohl RK, Hadeed S, Tabassi A, Tabassi A, Almas T. Enhancing glycaemic control and promoting cardiovascular health: the therapeutic potential of *Trigonella foenumgraecum* in diabetic patients - a systematic review and meta-analysis. *Ann Med Surg (Lond)*. 2024 Jan 25;86(6):3460-3467. doi: 10.1097/MS9.0000000000001750.
6. Li E, Maunder A, Liu J, Pandey C, Cave A, O'Fee A, Ee C. The efficacy and safety of herbal medicines for glycaemic control and insulin resistance in individuals with type 2 diabetes: an umbrella review. *BMC Complement Med Ther*. 2025 Sep 30;25(1):341. doi: 10.1186/s12906-025-05059-7
7. Nguyen V, Taine EG, Meng D, Cui T, Tan W. Pharmacological Activities, Therapeutic Effects, and Mechanistic Actions of Trigonelline. *Int J Mol Sci*. 2024 Mar 16;25(6):3385. doi: 10.3390/ijms25063385

8. Ranade M, Mudgalkar N. A simple dietary addition of fenugreek seed leads to the reduction in blood glucose levels: A parallel group, randomized single-blind trial. *Ayu.* 2017 Jan-Jun;38(1-2):24-27. doi: 10.4103/ayu.AYU_209_15
9. Sarker DK, Ray P, Dutta AK, Rouf R, Uddin SJ. Antidiabetic potential of fenugreek (*Trigonella foenum-graecum*): A magic herb for diabetes mellitus. *Food Sci Nutr.* 2024 Sep 5;12(10):7108-7136. doi: 10.1002/fsn3.4440
10. Hota D, Padhy BM, Maiti R, Bisoi D, Sahoo JP, Patro BK, Kumar P, Goel A, Banik SP, Chakraborty S, Rungta M, Bagchi M, Bagchi D. A Placebo-Controlled, Double-Blind Clinical Investigation to Evaluate the Efficacy of a Patented *Trigonella foenum-graecum* Seed Extract "Fenfuro®" in Type 2 Diabetics. *J Am Nutr Assoc.* 2024 Feb;43(2):147-156. doi: 10.1080/27697061.2023.2233008.
11. Verma N, Usman K, Patel N, Jain A, Dhakre S, Swaroop A, Bagchi M, Kumar P, Preuss HG, Bagchi D. A multicenter clinical study to determine the efficacy of a novel fenugreek seed (*Trigonella foenum-graecum*) extract (Fenfuro™) in patients with type 2 diabetes. *Food Nutr Res.* 2016 Oct 11;60:32382. doi: 10.3402/fnr.v60.32382.