

# Effect of fenugreek seeds on glycemia and dyslipidemia in patients with type 2 diabetes mellitus

Kamakhya Kumar<sup>1</sup>, Shiv Kumar<sup>2</sup>, Arunima Datta<sup>1</sup>, Arup Bandyopadhyay<sup>1</sup>

<sup>1</sup>Department of Physiology, MGM Medical College, Kishanganj, Bihar, India.

<sup>2</sup>Department of TB and Chest Medicine, MGM Medical College, Kishanganj, Bihar, India.

Correspondence to: Arunima Datta, E-mail: aminura.datta@gmail.com

Received March 11, 2015. Accepted March 31, 2015

## Abstract

**Background:** Fenugreek is an aromatic plant widely grown worldwide. Two fairly distinct types of plants are recognized—the dwarf type grown for culinary purposes and the tall type grown for medicinal purposes. It has small round leaves sold as vegetables (fresh leaves, sprouts) commonly known as *methi* and long pods that contained seeds known as *menthe*, which are used as such or in powdered form. These seeds are rich in soluble fibers and many phytochemical compounds. In addition to its hypoglycemic effect, the hypolipidemic effect of fenugreek seeds has also been documented. Therefore, fenugreek seeds have a dual role in the management of diabetes. It has been used as a herbal medicine in the management of glycemia and dyslipidemia since a long time in India.

**Objective:** To evaluate the effect of fenugreek seeds taken orally in patients with type 2 diabetes mellitus (DM) with dyslipidemia.

**Materials and Methods:** This prospective study was conducted on patients with type 2 DM with dyslipidemia after meeting inclusion and exclusion criteria. The patients were divided into two groups (age matched). One group received fenugreek seeds and other group received drugs (oral hypoglycemic and hypolipidemic agents). Lipid profile and HbA<sub>1c</sub> were measured initially as well as after 8 weeks of treatment period. Blood sugar (fasting) was recorded weekly. Student's *t*-test was applied for statistical analysis.

**Results:** After 8 weeks of treatment of fenugreek seeds in group 1 patients, there was a significant improvement in blood glucose Fasting level ( $178 \pm 72.4$  to  $104 \pm 28.2$ ;  $p < 0.0001$ ), T-cholesterol ( $350 \pm 20.6$  to  $176 \pm 17.2$ ;  $p < 0.0001$ ), triglycerides ( $280 \pm 18.2$  to  $132 \pm 16.8$ ;  $p < 0.0001$ ), low-density cholesterol ( $220 \pm 21.4$  to  $96 \pm 14.2$ ;  $p < 0.0001$ ), and high-density cholesterol ( $27.0 \pm 13.4$  to  $58 \pm 32.2$ ;  $p < 0.0002$ ). Although there was an improvement in HbA<sub>1c</sub> status but it was not significant.

**Conclusion:** This study supports beneficial effects of fenugreek seeds on glycemia and dyslipidemia in patients with type 2 DM and can be used as an adjuvant/alternative in management of diabetes and its complications.

**KEY WORDS:** Fenugreek seeds, glycemia, dyslipidemia

## Introduction

Since a long time, diabetes has been treated with plant medicines. It is believed that herbal products have few side

effects compared to chemical medicines. Many antidiabetic products of herbal origin are available in India. Hence, we planned to evaluate effect of one of them, that is, fenugreek (*Trigonella foenumgraecum*). These seeds have been shown to have an effect on cholesterol and blood sugar.<sup>[1]</sup> Fenugreek seeds are used for the treatment of diabetes mellitus (DM) in many parts of the world including India.<sup>[2-4]</sup> These seeds are high in soluble fibers, saponins, trigonelline, diosgenin, and 4-hydroxy leucine.<sup>[5,6]</sup> Soluble fibers like galactomannan help in lowering blood sugar by slowing down digestion and absorption of carbohydrates. Saponins form large mixed micelles with bile salts and significantly reduce cholesterol by increasing fecal excretion of bile salts, thereby inhibiting

Access this article online	
Website: <a href="http://www.ijmsph.com">http://www.ijmsph.com</a>	Quick Response Code: 
DOI: 10.5455/ijmsph.2015.11032015202	

International Journal of Medical Science and Public Health Online 2015. © 2015 Arunima Datta. This is an Open Access article distributed under the terms of the Creative Commons Attribution 4.0 International License (<http://creativecommons.org/licenses/by/4.0/>), allowing third parties to copy and redistribute the material in any medium or format and to remix, transform, and build upon the material for any purpose, even commercially, provided the original work is properly cited and states its license.

cholesterol absorption. 4-Hydroxy leucine found in these seeds stimulates insulin secretion in pancreas and lowers absorption of glucose.<sup>[7]</sup> Apart from effect on blood glucose and lipid profiles, this prized spice is an excellent source of minerals such as copper, potassium, calcium, iron, selenium, zinc, manganese, and magnesium. Potassium is an important component of cell and body fluids that helps control heart rate and blood pressure by counteracting on sodium. Iron is essential for red blood cells production and as a cofactor for cytochrome oxidase enzymes. It is also rich in many vital vitamins that are essential nutrients for optimum health, including thiamine, pyridoxine, folic acid, riboflavin, niacin, vitamin A, and vitamin C. This has been used in many traditional medicines as a laxative, a digestive, and a remedy for cough and bronchitis.

## Materials and Methods

Design of the study was prospective and was carried out on 50 already diagnosed patients with type 2 DM attending outpatient department of MGM Medical College and LSK Hospital Kishanganj, Bihar. The age of the patients was 40–60 years. All the patients were duly informed about the research work, possible effects, and side effects of fenugreek. They participated with their own interest, and written informed consent was taken from every one. The duration of this study was 2 months (8 weeks). Institutional ethics committee approval was obtained before the start of the study.

### Inclusion Criteria

1. Subject diagnosed with type 2 DM with dyslipidemia according to criteria of American Diabetes Association
2. Age 40–60 years
3. Fasting blood glucose more than 126 mg/dl
4. HbA<sub>1c</sub> more than 8%
5. Presence of dyslipidemia (deranged lipid profiles)
6. Glycemia and dyslipidemia not controlled with drugs

### Exclusion Criteria

1. Patients on insulin or any hypertensive drugs
2. Subjects having liver diseases, pulmonary tuberculosis, and alcoholism
3. Subjects with any diabetic complications such as neuropathy, nephropathy, or retinopathy
4. Patients with ischemic heart disease
5. Pregnant and lactating women

Patients meeting these inclusion criteria were put on standard diet and exercise for 1 month. Then they were divided into two groups: group 1 patients were given the standard treatment protocol, that is, diet, exercise and 5 g fenugreek seed powder four times a day before meal for 8 weeks. Group 2 patients were given the usual treatment protocol, that is,

diet, exercise, and oral hypoglycemic drugs, except fenugreek. Patients were assessed initially and then weekly for blood sugar fasting levels and on the end of eighth week for HbA<sub>1c</sub> and lipid profiles.

### Method of Examination

**Blood glucose fasting:** by glucose oxidase method with StatFax 3300 (Ark Diagnostic Pvt. Ltd., Bangalore, India).

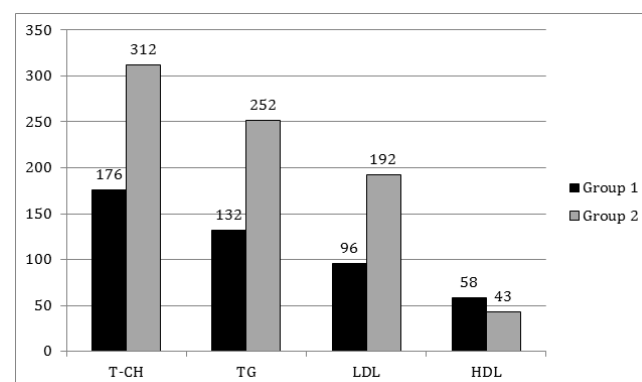
**HbA<sub>1c</sub>:** by DS5 Drew Scientific Machine (ion exchange chromatography; Drew Scientific Ltd., Cumbria, UK)

**Lipid Profiles:** reference values for plasma total cholesterol were obtained by using auto-analyzer systems to which either the ferric-chloride (sulfuric acid method) or Liebermann–Burchard test was adapted. A fluorometric analysis was used to determine triglyceride reference values. Plasma high-density lipoprotein (HDL) cholesterol determination done by the same procedures used for plasma total cholesterol, after precipitation of Apo-B-containing lipoproteins in whole plasma (low-density lipoprotein (LDL) and very low-density lipoprotein cholesterol) by heparin-manganese chloride. Lipoproteins can be separated by ultracentrifugation, precipitation, and electrophoresis. The quantitative reference method uses precipitation and ultracentrifugation sequentially to determine each lipoprotein component. Usually, measurement of plasma lipid level is sufficient for evaluations of patterns of lipoproteins elevations. Occasionally, paper electrophoresis of plasma is helpful.

### Safety Profile

Blood urea, serum bilirubin, liver transaminases (AST, ALT), serum creatinine, and prothrombin time were checked weekly.

At the end of 8 weeks, all the results were collected and analyzed by a statistician. The data for statistical analysis were assessed using SPSS, version 16 (SPSS Inc., Chicago, IL). Numerical variables were recorded as mean±SD. Statistical significance was computed by unpaired *t*-test. The level of significance was fixed at 5% ( $p < 0.05$ ).



**Figure 1:** Bar diagram showing the effect of fenugreek seeds on lipid profiles.

**Table 1:** Comparison of blood sugar profile (F) in weeks in groups 1 and 2

	Initial	2	4	6	8	t-Value	p-Value	Significance
Group 1 mean± SD	178±72.4	159±55.8	142±52.2	126±56.1	104±28.2	4.36	<0.0001	ES
Group 2 mean± SD	149±46.4	138±52.4	134±78.3	129±46.3	122±52.6	1.88	0.065	NS

**Table 2:** Comparison of HbA1c levels in groups 1 and 2

	Initial mean± SD	Final mean± SD	t-Value	p-Value	Significance
Group 1	12±3.2	10.6±3.7	1.31	0.197	NS
Group 2	9.25±2.8	8.45±1.8	1.16	0.248	NS

**Table 3:** Comparison of lipid profiles in groups 1 and 2

	Initial mean±SD	Final mean±SD	t-Value	p-Value	Significance
Group 1					
T-CH	350±20.6	176±17.2	29.71	<0.0001	ES
TG	280±18.2	132±16.8	27.38	<0.0001	ES
LDL	220±21.4	96±14.2	22.12	<0.0001	ES
HDL	27±13.4	58±32.2	4.07	<0.0002	ES
Group-2					
T-CH	322±23.2	312±26.4	1.39	0.170	NS
TG	261±17.8	252±21.2	1.59	0.118	NS
LDL	204±16.7	192±18.2	1.19	0.24	NS
HDL	32±18.4	43±19.8	1.99	0.052	NS

## Results

In this study, 50 patients of known cases of type 2 DM were enrolled. They were divided into two groups before the study. One group was considered as cases (group 1) and other group as controls (group 2) (Figure 1). From the group 1 four subjects and from group 2 one subject withdrew themselves from the study. Results of this study have been shown in Tables 1–3.

## Discussion

It is a well-known fact that attainment of good glycemic control in patients with type 2 DM is not always adequate and may require some additional/alternative approach. This study was undertaken to evaluate the efficacy of fenugreek seeds for controlling glycemia and dyslipidemia in patients with type 2 DM. Various studies have been conducted to see the effect of high-fiber diet, fenugreek, and other herbal agents in the management of diabetes. In our study, intake of fenugreek seeds resulted in significant reduction in blood glucose (F), T-CH, LDL and triglycerides (TG) with significant increase in HDL. Although there was a beneficial effect on HbA<sub>1c</sub>, but statistically, it was not significant. This fact was also supported by the research study by Neelakantan et al.<sup>[6]</sup> The results of a study conducted by Zargar et al.<sup>[9]</sup> are very similar to that of this study. ICMR (Indian Council of Medical Research) in its bulletin described the alkaloids of fenugreek and also reported the antidiabetic action of fenugreek seeds.<sup>[10]</sup> Similar results were also obtained by some other studies.<sup>[11–13]</sup> Italian

herbalists frequently suggested fenugreek for glycemic control.<sup>[14]</sup> Studies in animals such as diabetic dogs and rats also showed that fenugreek seed intake increased insulin sensitivity and reduced blood glucose levels.<sup>[15–17]</sup> Lipid-lowering effect of fenugreek may be an additional benefit in patients with type 2 DM with dyslipidemia.<sup>[18–20]</sup>

El-Soud et al.<sup>[21]</sup> found in albino rats with experimental diabetes induced by streptozotocin that during diabetes liver shows decrease in weight due to enhanced catabolic processes such as glycogenolysis, lipolysis, and proteolysis, which is the outcome of lack of insulin and/or cellular glucose in liver cells. There is, however, an increase in kidney weight due to glucose excess and subsequent enhancement in glycogen synthesis, protein synthesis, and lipogenesis.<sup>[22]</sup> These changes may lead to serious microvascular renal complications involving a series of metabolic changes in the pathogenesis of diabetic nephropathy.<sup>[23]</sup> Studies indicated treatment of diabetic rats with fenugreek alkaloids significantly prevented the alteration in liver and kidney weight and pathology with return to their normal texture.<sup>[24]</sup>

The principal hypoglycemic alkaloid in fenugreek seed is trigonelline (0.2–0.36%). However one study has shown that the purified hypoglycemic principle of fenugreek seeds is different from that of alkaloid trigonelline based on UV and IR absorption spectra, thin-layer chromatography, and high-performance liquid chromatography criteria. This highly active hypoglycemic principle isolated from fenugreek seed increases glucose-induced serum insulin levels and improves glucose tolerance after treatment with a dose of 100 mg/kg in alloxan-induced diabetic rabbits. There was an improvement

in glycosylated hemoglobin and serum lipid profile. There was an increase in the activity of the key enzymes of glycolysis in muscle but not in the liver. Slight inhibition in the activity of gluconeogenic enzymes was also noticed, proving thereby that the active compound acts at both pancreatic and extrapancreatic sites.<sup>[25]</sup> Thus, our studies in humans confirm that crude fenugreek seeds including trigonelline and others do have a good overall effect on DM and its complications.

## Conclusion

We show that fenugreek seeds may be a promising additional option for management of diabetes as these are widely available at low cost in poor countries like India but certain things should be kept in mind before prescribing fenugreek seeds to diabetic patients:

1. It must be standardized and tested for its composition
2. It should be consumed 20 min before intake of food every time (breakfast, lunch, dinner, and snacks)
3. The amount should be same even if small meal or snack (i.e., 5 g) is taken
4. If on current oral medications, use of this herbs should be at least 2 h before or after these drugs because fenugreek fiber has the potential to interfere with the absorption of oral medication due to its mucilaginous contents (which gives it a moist and sticky texture)
5. Fenugreek use in pregnancy is not recommended as it has the potential to induce labor
6. Fenugreek seeds DO NOT cure diabetes but helps in blood sugar control

## References

1. Nadkarni KM. *Trigonella Foenum Graecum*: Indian Materia Medica 1993;1240–9.
2. Kirtekar KR, Basu BD. *Indian Medicinal Plants*. 3rd edn. Allahabad, India: Latif Mohsin Prakashan, 2000.
3. Saxena A, Vikram NK. Role of selected Indian plants in management type 2 diabetes: a review. *J Altern Complement Med* 2004;10:369–78.
4. Wang E, Wylie-Rosette J. Review of selected Chinese herbal medicine in treatment of type 2 diabetes. *Diabetes Educ* 2008;34:645–54.
5. Council of Scientific and Industrial Research. *The Wealth of India*. Cossain and Company Pvt Ltd, Calcutta 1976;10:299–305.
6. Neerja A, Rajyalaxmi P. Hypoglycemic effect of processed fenugreek seeds in humans. *J Food Sci Technol* 1996;33:427–30.
7. Sauvare Y, Petit P, Broca C, Manteghetti M, Ribes G. 4-hydroxy leucine: a novel amino acid potentiator of insulin secretion. *Diabetes* 1998;47:206–10.
8. Neelakantan N, Madangopal N, Russel D'Souza, Rob Van Dam. Effect of fenugreek (*Trigonella foenum-graecum* L.) intake on glycemia: a meta-analysis of clinical trials. *Nutr J* 2014;13:7.
9. Zargar AH, Nehru A, Laway BA, Dar FA. Effect of consumption of powdered fenugreek seeds on blood sugar and HbA<sub>1c</sub> levels in patients with type 2 DM 1992;12:49–51.
10. Role of fenugreek in diabetes mellitus. *ICMR Bull* 1987;17:79–92.
11. Shanmugasudaram ER, Gopinath KL, Radha Shanmugasundaram K, Rajendran VM. Possible regeneration of islets of Langerhans in streptozotocin-diabetic rats given *Gymnema sylvestre* leaf extracts. *J Ethnopharmacol* 1990;3:265–71.
12. Cokici I, Hurmoglu C, Tunctan B, Abacioglu N, Kanzik I, Sener B. Hypoglycemic effect of *Momordica charantia* extract in normoglycemic or cyproheptadine induced hyperglycemic mice. *J Ethnopharmacol* 1994;44:117–21.
13. Ng TB, Wang CM, Li WW, Yeung HW. Insulin like molecules in *Momordica charantia* 1986;15:107–17.
14. Cicero AF, Derosa G, Gaddi A. What do herbalists suggest to diabetic patients in order to improve glycemic control. Evaluation of scientific evidence and potential risks. *Acta Diabetol* 2004;41:91–8.
15. Zhore J, Chan L, Zhou S. Trigonelline: a plant alkaloid with therapeutic potential for diabetes and CNS diseases. *Curr Med Chem* 2012;19:3523–31.
16. Ribes G. Effect of fenugreek seeds on endocrine pancreatic secretion in dogs. *Ann Nutr Metab* 1984;28:27.
17. Ali L, Azad Khan AK, Hassan Z, Mosihuzzaman M, Nahar N, Nasreen T, et al. characterization of hypoglycemic effects of *Trigonella foenum graecum* seed. *Planta Med (Germany)* 1995;61:358–460.
18. Kassain N, Azadbakht L, Forghani B, Amimi M. Effect of fenugreek seeds on blood glucose and lipid profiles in type 2 diabetic patients. *Int J Vitam Nutr Res* 2009;79(1):34–9.
19. Sharma RD, Raghuram TC, Rao NS. Effect of fenugreek seeds on blood glucose and repeats in type 1 diabetes. *Eur J Clin Nutr* 1990;44:301–6.
20. Prasanna M. Hypolipidemic effect of fenugreek: a clinical study. *Indian J Pharmacol* 2000;32:34–6.
21. EL-Soud NHA, Khalil MY, Hussain JS, Oraby FSH, Farrag ARH. Antidiabetic effects of fenugreek alkaloid extract in streptozotocin induced hyperglycemic rats. *J Appl Scs Res* 2007;3(10):1073–83.
22. Meyer C, Stumvoll M, Nadkarni V, Dostou J, Mitrakou A, Gerich J. Abnormal renal and hepatic glucose metabolism in type 2 diabetes mellitus. *J Clin Invest* 1998;102:619–24.
23. Raju J, Gupta D, Rao AR, Yadav PK, Baquer NZ. *Trigonella foenum graecum* (fenugreek) seed powder improves glucose homeostasis in alloxan diabetic rat tissues by reversing the altered glycolytic, gluconeogenic and lipogenic enzymes. *Mol Cell Biochem* 2001;224:45–51.
24. Devi BA, Kamalakannan N, Prince PS. Supplementation of fenugreek leaves in diabetic rats. Effect on carbohydrate metabolic enzymes in diabetic liver and kidney. *Phytother Res* 2013;17(10):1231–3.
25. Moorthy R, Prabhu KM, Murthy PS. Studies on the isolation and effect of an orally active hypoglycemic principle from the seeds of fenugreek (*Trigonella foenum graecum*). *Ind J Biochem Biophys* April 1989;69–72.

**How to cite this article:** Kumar K, Kumar S, Datta A, Bandyopadhyay A. Effect of fenugreek seeds on glycemia and dyslipidemia in patients with type 2 diabetes mellitus. *Int J Med Sci Public Health* 2015;4:997-1000

**Source of Support:** Nil, **Conflict of Interest:** None declared.