**Therapeutic role of *Trigonella foenum-graecum* [Fenugreek] – A Review**

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**ABSTRACT**

Herbs have high medicinal value in Indian homes and proved to arrest, reduce and terminate most of the disease by the use of active constituents prepared out of them. From the ancient time onwards, *Trigonella* was found on the continents of Asia, Europe, Africa and Australia. The species name "*foenum-graecum*" means "Greek hay" indicating its use as a forage crop in the past. *Trigonella foenum-graecum* was used as a traditional remedy for the treatment of various diseases. In this study after a general discussion of chemical constituents, the biological and pharmacological actions of fenugreek such as Anti-diabetic activity, Hypcholesterolaemic properties, Immunomodulatory activity, Anti-toxic activity, Anti-cataract activity and Anti-oxidant activity were briefly reviewed. This review article summarizes the published experimental research and scientific literature from the databases including PubMed, Google and local library searches. The results of these studies provide a complete understanding of the biological action of fenugreek.

**Keywords:** Immunomodulatory, Pharmacological activity, Anti-cancer activity, Anti-toxic activity.

**INTRODUCTION**

Herbs are rendering an acknowledgment; including herbal ‘renaissance’ is a phenomenon all over the world. The herbal products, today, represent security had viewed in contrast to the synthetics as hazardous to human and environment. Even though herbs been valued for their remedial, flavoring and fragrant qualities for ages, the synthetic products of the new age surpassed their importance for a while. The blind dependence on synthetics is over, and people are turning to the naturals with th

Fenugreek has different pharmacological attributes such as a hypoglycemic, hypercholesterolemia, gastroprotective, chemo-preventive, an anti-oxidant and laxative and appetite stimulation. The plant contains alkaloids, flavonoids, salicylate, and nicotinic acid. Fenugrecks are harmless for human consumption.

**Table 1:** Common names for *Trigonella foenum-graecum*

<table>
<thead>
<tr>
<th>Language</th>
<th>Common Names</th>
</tr>
</thead>
<tbody>
<tr>
<td>Kannada</td>
<td>Menthya</td>
</tr>
<tr>
<td>Tamil</td>
<td>Vendayam, Meti</td>
</tr>
<tr>
<td>Telugu</td>
<td>Menthulu</td>
</tr>
<tr>
<td>Malayalam</td>
<td>Uluva</td>
</tr>
<tr>
<td>Sinhalese</td>
<td>Uluhaal</td>
</tr>
<tr>
<td>Persian</td>
<td>Shanballeh</td>
</tr>
<tr>
<td>Arabic</td>
<td>Hulba, Hilbeh</td>
</tr>
<tr>
<td>Oriya, Urdu, Hindi, Punjabi, Bangla</td>
<td>Methi</td>
</tr>
<tr>
<td>Nepali</td>
<td>Menthiyam</td>
</tr>
<tr>
<td>Burmese</td>
<td>Penantazi</td>
</tr>
<tr>
<td>English</td>
<td>Fenugreek</td>
</tr>
<tr>
<td>Hindi</td>
<td>Methi, Sag methi (fresh leaves), Kasuri methi (dried leaves)</td>
</tr>
<tr>
<td>French</td>
<td>Fenugrec, Sénegré, Trigonelle</td>
</tr>
<tr>
<td>Galician</td>
<td>Fenogreco, Alforsa</td>
</tr>
<tr>
<td>German</td>
<td>Bockshornklee, Griechisch Heu</td>
</tr>
<tr>
<td>Georgian</td>
<td>Solinji, Chaman</td>
</tr>
<tr>
<td>Japanese</td>
<td>Koruha, Fenu-guriku</td>
</tr>
<tr>
<td>Dutch</td>
<td>Fenegriek</td>
</tr>
<tr>
<td>Romanian</td>
<td>Molotru, Molotru comun, Schinduf</td>
</tr>
<tr>
<td>Russian</td>
<td>Pazhitnik grecheski, Shambala, Pazhitnik cennoj</td>
</tr>
<tr>
<td>Assamese</td>
<td>Methi, Mithi, Mithi g</td>
</tr>
<tr>
<td>Sanskrit</td>
<td>Methika</td>
</tr>
<tr>
<td>Malay</td>
<td>Halba, Kelabet</td>
</tr>
</tbody>
</table>

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Table 2: Taxonomy of *Trigonella foenum-graecum*

<table>
<thead>
<tr>
<th>Kingdom</th>
<th>Plantae</th>
</tr>
</thead>
<tbody>
<tr>
<td>Super division</td>
<td>Angiosperms</td>
</tr>
<tr>
<td>Division</td>
<td>Eudicots</td>
</tr>
<tr>
<td>Class</td>
<td>Rosids</td>
</tr>
<tr>
<td>Order</td>
<td>Fabales</td>
</tr>
<tr>
<td>Family</td>
<td>Fabaceae</td>
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<tr>
<td>Subfamily</td>
<td>Faboideae</td>
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<tr>
<td>Tribe</td>
<td>Trifoliae</td>
</tr>
<tr>
<td>Genus</td>
<td>Trigonella</td>
</tr>
<tr>
<td>Species</td>
<td>Foenum</td>
</tr>
</tbody>
</table>

The anti-diabetic properties of a Soluble Dietary Fibre (SDF) fraction of *Trigonella foenum-graecum* were evaluated. Administration of SDF fraction [0.5 g/kg body weight] to normal, type 1 or type 2 diabetic rats significantly improved oral glucose tolerance. Effects of soluble dietary fibre of *Trigonella foenum-graecum* on sucrose absorption from the gut, on intestinal glucose absorption, on intestinal disaccharidase activity and gastrointestinal motility, on insulin secretion, on glucose uptake and insulin action were determined. They demonstrated that SDF fraction of *Trigonella foenum-graecum* significantly improved glucose homeostasis in type I and type II diabetes by delaying carbohydrate digestion and absorption, and enhancing or mimicking insulin action. After oral sucrose ingestion in non-diabetic and type 2 diabetic rats, SDF fraction suppressed the elevation of blood glucose. Glucose transport in 3T3-L1 adipocytes and insulin action was increased by *Trigonella foenum-graecum*. They indicated that the SDF fraction of *Trigonella foenum-graecum* seeds applies anti diabetic effects mediated during inhibition of absorption and carbohydrate digestion, and enhancement of peripheral insulin action.

The effect of oral administration of Fenugreek whole seed powder [5% in the diet] for 21 days in alloxan-induced diabetic Wistar rats were studied, the glycolytic, gluconeogenic and NADH-linked lipogenic enzymes were determined in the liver and kidney tissues of rats. Fenugreek seed powder treatment to diabetic rats for 21 days brought down the high fasting blood glucose levels to control levels. The altered enzyme activities were restored to control values in both the liver and kidney after fenugreek seed powder treatment. The biochemical effects exerted by fenugreek seeds make it a potential new curative effect in type-1 diabetes. The anti-diabetic actions of fenugreek seeds in part have been considered as to the presence of steroid, saponins and fibre content in the seeds.

The isolation of furostanol saponins called trigoneosides, glycoside D and trigofenoside A were and the determination of steroidal sapogenins like diosgenin and yamogenin were identified in the fenugreek. Pharmacological experiments performed *in vivo* in normal and streptozotocin induced diabetic rats resulted in increased food intake and consequent progressive weight gain in the diabetic rats treated with the furostanol saponins, in contrast to the untreated diabetic rats. It was identified that *Trigonella* seed powder treatment to diabetic rats affects key glycolytic, gluconeogenic and NADH-linked lipogenic enzymes. The change in the activities of enzymes effected by *Trigonella* seed powder treatment as elucidated in this study suggest that a normal glucose metabolism, in peripheral tissues such as liver and kidneys, is critical in achieving normoglycemia. Intermit therapy is possible with the potent product GI of fenugreek which is of great benefit in diabetes induced rabbits.
The effect of fenugreek saponin in diabetic rats was analysed. The fenugreek saponin fraction significantly modulated the disaccharidase and glycogen enzyme activities in the intestine; it increased the hepatic glycogen content, suppressed the increase of blood glucose level and improved results in the Oral Glucose Tolerance Test [OGTT]. The fenugreek saponin extract also efficiently protected the hepatic function, which was by the significant increases of superoxide dismutase [SOD], catalase [CAT], glutation peroxidase [GPX], aspartate transaminase [AST], alanine transaminase [ALT] and lactate dehydrogenase [LDH] enzyme activities. Fenugreek saponins reveal attractive properties and can be considered as capable candidates for potential purpose as therapeutic agents in biotechnological with bioprocess based technologies, mainly those related to the improvement of anti-diabetic, hepatoprotective and hypolipidemic drugs.  

**Lipid profile**

Atherosclerosis and its problems compose the mainly common cause of death in Western societies. Oxidative modification of LDL [low-density lipoprotein] is an important, if not obligatory event in atherosclerosis. Inhibition of LDL oxidation can lessen the risk of atherosclerosis independent of reducing plasma cholesterol levels. A diet rich in fibre and vegetables has to reduce the atherogenesis and it is the first line of management. The effect of fenugreek on blood lipids, blood sugar, platelet aggregation, fibrinogen and fibrinolytic activity were assessed. Healthy individuals, patient of Coronary Artery Disease [CAD], and patients with Non-insulin Dependent Diabetes Mellitus [NiDDM], who either had CAD or were without CAD. Fenugreek given in a dose of 2.5g twice daily for 3 month to healthy individuals does not change the blood lipids and blood sugar [fasting and post prandial]. Though, administered in the same daily dose for some duration to CAD patients also with NiDDM, fenugreek significantly reduce the blood lipids without affecting the HDL-C while administered in the same daily dose to NiDDM patient [mild cases], fenugreek reduced the blood sugar. In severe NiDDM cases, the blood sugar was only slightly reduced; fenugreek did not affect platelet aggregation, fibrinolytic activity and fibrinogen.

The hypocholesterolemic properties of ethanol extract from defatted fenugreek seeds were studied. Purification of the crude extracts by dialysis produced an isolated component with hemolytic characteristics. The dialysate was also found to include saponins shown by thin-layer chromatography. In two separate feeding trials, hypercholesterolemic rats were supplied on 30 or 50 g ethanol extract/kg for a 4-week time. Reductions in plasma cholesterol levels ranged from 18 to 26%, and a tendency for lower concentrations of liver cholesterol was examined. The ethanol extract from fenugreek seeds contained hypocholesterolemic components that look to be, saponins that interact with bile salts in the digestive tract. The focus on the contribution of an ethanol [EtOH] extracts obtained from ground fenugreek seeds in reducing cholesterol levels in hypercholesterolemic rats. Hence, fenugreek contains biologically-active components which do not directly, interact with cholesterol.

In order to investigate how chemically diverse fibres differ in their hypolipidemic activity, mucilage of varying chemical composition isolated from three different sources were administered to experimental animals, and the metabolism of lipids and lipoproteins was studied. One of the mucilage used was a galactomannan isolated from fenugreek [Trigonella foenum graecum] seeds. Rats were fed with mucilage at a dose of 4 mg/100 g body weight per day for 8 weeks, and changes in the levels of total cholesterol and triacylglycerols in serum, liver and aorta were analysed. A greater lipid-lowering effect was shown by mannan like Glucomannan and galactomannan than arabinagalactan. The hypolipidemic effect of this mucilage appears to be due to a decrease in the synthesis and secretion of VLDL by hepatocytes. A reduction in production of VLDL can be due to a decrease in the synthesis of apoB as well as lipids associated with VLDL. Polyphenols present in fenugreek seeds play a significant role in mitigating lipid abnormalities and maintaining collagen content and properties during alcohol-induced liver damage. Besides the prevention of collagen cross linking, the benefits of fenugreek might be related to anti-inflammatory activity and effects on IL-6, TNF-α, and enzyme systems responsible for collagen synthesis and degradation.

The impact of a novel fibre mix of fenugreek seed powder, guar gum and wheat bran [Fibernat] on LDL oxidation was evaluated. Fibernat administration thus prevented the oxidative modification of LDL; the LDL + VLDL fraction also displayed a resistance to oxidative modification. Plasma antioxidant status with respect to GSH was enhanced. In general, these studies imply that Fibernat intake could reduce the risk for atherosclerosis and other disorders of lipid metabolism in rats.

**Immunomodulatory and anti-toxic activity**

Immunomodulatory activity of the aqueous extract of fenugreek was assessed in male swiss albino mice. Mice were treated with three doses of extract [50, 100, 250 mg/kg body weight] for 10days. The response at the higher dose, i.e. at 250 mg/kg, was either identical to control group animals or mildly stimulated as compared to control animals. The increase in thymus weight was accompanied by an increase in its cell counts. This may be partly due to the stimulatory effect of plant extract on the lymphocytes and bone marrow hematopoietic cells, which ultimately home in the thymus. Trigonella foenum graecum showed stimulatory effects on macrophages. Phagocytosis of microorganisms by macrophages of against Trigonella foenum graecum has immune stimulatory.
Cypermethrin [CM] is an important type II pyrethroid pesticide used widely in pest control and is to cause hepatic and renal toxicity. Oxidative stress and lipid peroxidation [LPO] have been involved in the toxicology of pyrethroids. The protective power of aqueous extract of germinated fenugreek seeds in CM-induced hepatic and renal toxicity were studied. CM treatment has caused increases thiobarbituric acid reactive substances [TBARS], depletion in glutathione [GSH] and decrease in the activities of superoxide dismutase [SOD], catalase [CAT], glutathione peroxidase [GPx] and glutathione-S-transferase [GST] in the liver and kidneys. The activities of tissue antioxidants SOD, CAT, GPx and GST, decreased significantly [p < .05] in CM-treated rats while the CM and germinated fenugreek seed extract treated rats displayed a notable increase [p < .05] in all the tissue antioxidants when compared with the CM-treated rats.

Aqueous extract of fenugreek was reported to ameliorate additive urototoxicity of buthionine, sulfoximine and cyclophosphamide by restoring the anti-oxidant status and reversing the cyclophosphamide-induced apoptosis in free radical-mediated LPO in the urinary bladder. Fenugreek in the diet showed a marked reduction in diabetes-induced polydypsia, hyperglycemia, polyuria, urine sugar, renal hypertrophy and glomerular filtration rate.

Numerous useful physiological properties and strong anti-oxidant potential and its widespread availability, the neutrcutecal value of fenugreek makes it an ideal candidate to protect against pesticide-induced toxicity and the inhibition of fenvalate toxicity in vitro by fenugreek seeds in blood samples of healthy human volunteers [22-26 years].

Anti-cataract Activity

Cataract is the opacification in the eye lens and leads to 50% of blindness worldwide. Cataract remains the leading cause of visual disability, and it contributes 50% blindness worldwide. Several risk factors have been known in the pathogenesis of senile cataract. Despite aging, diabetes, smoking, gender, steroids, and nitric oxide are liable for the growth of cataract.

The anti-cataract potential of Trigonella foenum-graecum L seeds [fenugreek] in selenite-induced in vitro and in vivo cataract was evaluated. In vitro enucleated rat lenses were maintained in organ culture containing Dulbecco’s modified Eagles medium [DMEM] alone or in addition with 100 µM selenite and served as standard and control groups, respectively. For the test group, the medium was supplemented with selenite and Trigonella foenum-graecum aqueous extract. The lenses were incubated for 24 h at 37°C. After incubation, the lenses were processed for the estimation of reduced glutathione [GSH], lipid peroxidation product [malondialdehyde], and the antioxidant enzymes. A fall in GSH and a rise in malondialdehyde levels were seen in control as compared to standard lenses. Trigonella foenum-graecum drastically [P< 0.01] restored glutathione and decreased malondialdehyde levels. An important restoration in the activities of anti-oxidant enzymes such as superoxide dismutase (P<0.01), catalase, (P<0.01), glutathione peroxidase (P<0.01), and glutathione-S-transferase (P<0.01) was observed in the Trigonella foenum-graecum supplemented group as compared to control. Trigonella foenum-graecum protects against the experimental cataract by virtue of its anti-oxidant properties. GSH level in the normal group was found to be 1.19±0.24 µmol/g. There was a significant reduction, in GSH level, in the presence of selenite stress, and the level was found to be 0.11± 0.05 µmol/g of lens in the control group. Fenugreek supplemented group significantly restored the GSH level in a dose-dependent manner. It was observed that, in the presence of selenite stress, antioxidant enzymes were reduced as compared with the average group.

Anti-oxidant activity

Crude extracts of fenugreek were prepared by soxhlet extraction process with different solvents such as ethanol, methanol, acetone, ethyl acetate, dichloromethane and hexane. Extracts were subjected for the measurement of total phenolic content by Folin-Ciocalteu method as well as chelating activity, flavonoid content, antioxidant/radical scavenging activity, reducing powder and free radical scavenging activity. The results show that all extracts of the fenugreek exhibit anti-oxidant activity. The seeds include rich proteins and mucilaginous fiber and other rare chemical constituents such to account for much cholesterol to sugar levels. Ethanolic extract of fenugreek seeds was shown highest anti-oxidant activity [% DPPH scavenging activity]. The anti-oxidant activity could be associated with the polyphenolic components present in the extract.

Fenugreek seeds could modulate the activity of glyoxalase system SOD, catalase and GST. Fenugreek seeds seem to have a dual effect on the tissues as is visible from the enhanced anti-oxidant state at lower doses and pro-oxidant effect at higher doses. Anti-diabetic and hypoglycemic properties could be connected, to its ability to increase the activity of gly I and anti-oxidant potential.

Associated use of fenugreek might lower serum glucose level and its mucilage possesses a hypolipidemic effect. The anti-hypercholesterolemic and anti-atherogenic effects of the mucilage galactomannan isolated from fenugreek seeds were also studied in experimental rabbits. An aqueous extract of fenugreek seeds were examined for its anti-radical and in vitro anti-oxidant activity in different model systems. The radical activity could be correlated with the polyphenolic compound present in the extract, and the result of this process provides some important factors responsible for anti-oxidant potentials of fenugreek seeds.
The functional food quality of fenugreek seeds were assessed by determining the lipid peroxidation [LPO] and cyclooxygenase enzyme [COX] inhibitory activities in hexane, ethyl acetate, methanolic and water extracts using MTT, LPO, COX-1 and COX-2 enzyme inhibitory assays. The extracts inhibited LPO by 55–95%, COX-1 by 6–87% and COX-2 by 36–70%, respectively, at 250 g/ml. Bioassay-guided purification of these extracts yielded triglycerides, fatty acids, saccharides and flavonoid-C-glycosides. The antioxidant and anti-inflammatory activities exhibited by the isolated compounds from fenugreek seeds support its anecdotal health applications.59

Other medicinal uses

The fenugreek seeds are important in keeping a healthy digestive system; thus thecontinue, and daily use of this spice may increase the digestibility of eaten food, which may further promote good absorbing capacity of food constituents in blood for best metabolic use in the body cells. Fenugreek seeds have restorative and nutritive properties. The daily use of fenugreek seeds as the dietary supplement is safe. It has good beneficial effects to increase blood Hg by natural means. This might extra help avoid and cure anemia and have good healthy life for longer duration in females of child bearing age.70

Modulatory effect of fenugreek seeds on 1, 2-dimethylhydrazine-induced hepatic oxidative stress during colon carcinogenesis was studied in male wistar rats.71 It was identified that in pulverized seed of fenugreek in the diet of DMH treated rats reduced the colon incidence up to 16.6%.

Acetylcholinesterase inhibitors [AChEI] give a significant relief to some of the clinical signs of the disease. They studied to regulate the extract of fenugreek with trigonelline by HPTLC method and determine the in vitro AChE inhibitory activity of fenugreek and its components using galantamine as a reference. From this, they showed that the fractions and trigonelline fenugreek seed has a potential AChE inhibitory activity and could be used for the cure of Alzheimer’s disease.72

Table 3: Potential Medicinal Values of Trigonella foenum-graecum

<table>
<thead>
<tr>
<th>Traditional Uses</th>
<th>Pharmacological Activities</th>
<th>Side Effects of Fenugreek</th>
</tr>
</thead>
<tbody>
<tr>
<td>To treat arthritis, asthma, bronchitis, improve digestion, increase libido and male potency, to cure skin problems (wounds, rashes and boils), to treat sore throat, and cure acid reflux, treatment of reproductive disorders, to induce labor, to treat hormonal disorders, to help with breast enlargement, and to reduce menstrual pain, blood Sugar Regulation</td>
<td>Anti-diabetic Anti-inflammatory Anti-toxic Anti-cancer Hypoglycemic, hypercholesterolemia, gastroprotective, chemopreventive, antioxidant, laxative, appetite stimulation, Anti-cataract, Immunomodulatory activity, Anti-atherogenic</td>
<td>Minor side effects such as Nausea, Gastrointestinal discomfort (diarrhea and/or gas)</td>
</tr>
</tbody>
</table>

CONCLUSION

The Present review highlights the value of different pharmacological activities of Trigonella foenum-graecum (Table 3). Enormous studies were done for this plant; however novel therapeutic activities were briefly discussed in this study. Thus anti-toxic potential, anti-cataract effect of this plant is a significant pharmacological activity, which should be focused more in the future.

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