



REVIEW ON Phytochemical and Pharmacological Evaluation Of Antidiabetic Plant Trigonella Foenum-graecum Used By Traditional Healers :

Corresponding Authors:

1.prathamesh Adinath Bhosale

Sarsam College of Pharamacy, Palshiwadi, Sub District-Baramati, District- Pune

2.Yogesh Bharat budhanavar

Sarsam College of Pharamacy, Palshiwadi, Sub District-Baramati, District- P

Guided By:

Prof. Charushila Bhintade
M. Pharm

Phytochemical and Pharmacological Evaluation Of Antidiabetic Plant Trigonella Foenum-graecum Used By Traditional Healers :

ABSTRACT :

Trigonella foenum-graecum plant is also known as methi and used in Ayurvedic medicines for the treatment of bronchitis, rheumatoid arthritis, abscesses or wounds and digestive abnormalities. It has been found to have antimicrobial, wound healing, antifungal, anti-diarrheal, hypoglycemic, hepatoprotective, antioxidant, antihelminthic, anti-diabetic, anti-inflammatory activity. It also used in treatment of small pox and hair loss. The seed contains two alkaloid namely choline, and trigonelline. It also contains four flavanoid (two glycosides and two aglycones) and two steroidal saponins. In modern food technology Fenugreek is used as food stabilizer, adhesive and emulsifying factor because of its gum, protein and fiber content. It is a rich source of calcium, iron and other vitamins. In this study after a general discussion of physio-chemical constituents, the biological & pharmacological reactions of Fenugreek.

Keywords: Trigonella foenum-graecum, Fenugreek and pharmacological properties

1. INTRODUCTION

Trigonella foenum-graecum (Fabaceae) commonly known as Methi or metha in local language Hindi. It is a well known herb in the Ayurvedic system of medicine.¹ Fenugreek is as one of the oldest cultivated medicinal plants identified in written history, and further studies evaluated that the seeds and leaves of fenugreek having antioxidant properties². India is one of the major producers of the Trigonella foenum-graecum L. all over the world and the production is approximately 45,000-55,000 tonnes per annum. According to historical facts, the classical texts of Ayurveda, Charak Samhita and Sushruta Samhita were written around 1000 B.C. and these include 600 medicinal plants along with therapeutics³. T. foenum-graecum is used as a traditional medicinal plant around the world due to its diverse nature of phytoconstituents, such as steroids, saponins, diosgenin, gitogenin, glycosides, hydrocarbons, amino acids, and gingerol. It is a small annual herb found in different parts of India. The extensive use of plant-derived medicines and medicinal plants in traditional cultures globally has enhanced the incorporation of phytochemicals into contemporary products for disease treatment and health promotion. T. foenum-graecum is used as a medicinal plant for the treatment of diabetes mellitus [13], rheumatic arthritis, injuries, muscular weakness, throat infections, hypertension [14], neurological disorders, and cardiac diseases [15]. Several studies showed the androgenic and anabolic effects of T. foenum-graecum in human reproductive physiology. The hydrolysates proteins obtained from the rhizome extract T. foenum-graecum showed anticancer potential as they minimized the levels of reactive oxygen species. Hydrolysates are a rich source of protein and are also used for the treatment of colorectal cancers. It has two fairly distinct types of plants recognized: the dwarf type, grown for culinary purposes and the tall growing type, known as Metha in Punjab, grown for fodder use⁴.





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BOTANICAL CLASSIFICATION OF T. FOENUM GRAECUM

Kingdom : Plantae

Division : Magnoliophyta Class Magnoliopsida Order : Fabales

Family : Fabaceae Genus : Trigonella

Species : Trigonella foenum graecum

MORPHOLOGY :

Appearance: Solid-rhomboidal seeds, 3 to 5 mm long, 2 mm thick. Hard, pebble-like. Colour: Yellowish brown-light brown

Odour: characteristic spicy Taste : Bitter and mucilaginous.

Table 1: Common Names of Fenugreek Language Common Names :

Tamil: Meti Telugu : Menthulu Malayalam : Uluva Sinhalese : Uluhaal Oriya : Hulba

Hindi, Urdu, Punjabi : Methi

English : Fenugreek

Hindi : Methi, Saag methi, Kasuri methi Sanskrit : Methika

II. CHEMICAL CONSTITUENTS :



It contains Alkaloid, flavanoid, carbohydrate, protein, amino acids, vitamins, and minerals⁵. It contain two alkaloid trigonelline and choline⁶. The seed also contains two flavanoid known as quercitin and luteolin found active as antioxidant. Different amino acid and 30% protein present infenugreek seeds. Common solvent for protein 70% alcohol, saline water, distilled water⁸.

Physico-chemical constituents of Fenugreek seeds

The different alkaloids, saponin and flavonoids are to be found in fenugreek, but saponin are to be found to be high level concentration in the fenugreek⁹. Alkaloids and volatiles are the two major constituents of fenugreek seed which causes bitter taste and bad odour¹⁰. Fenugreek seed especially rich in vitamins-A, B1, B2, C, niacin and nicotinic acid where as germinating seeds contains pyridoxine, calcium pantothenate, biotin & Ascorbic acid¹¹. Fenugreek does not having so much minerals but it has good amount of phosphorus and sulphur . It is also known for its higher occurrence of calcium, iron and zinc. In 1997, this study investigated the following compounds based on the fenugreek aroma detection by the help of gas chromatography: acetic acid, linalool, isovaleric acid, butanoic acid, 3-isopropyl-2-methoxypyrazine, olfactometry diacetyl, eugenol, caproic acid, 3-Amino-4, 5-dimethyl-3, 3-isobutyl-2-methoxypyrazine. The fenugreek gum can be utilized for thickening, stabilizing and emulsifying food agents. Fenugreek gum is less exploited in the food industry as compared to other gums. Fenugreek gum is originated from the endosperm of the seeds and it consists of mannose & galactose. Whenever making bread with wheat flour with combination of fenugreek, the prepared dough showed more water absorption in spite to the dough made without fenugreek gum Fenugreek endosperm is highly rich in protein such as globulin, albumin, histidine and lecithin¹². The fiber content of fenugreek seed extract plays a role in its ability to moderate metabolism of glucose in the digestive tract . The 100g of seeds gives more than 65% of dietary fibers. Fiber binds to toxins in the food and helps to prevention of the colon mucus membrane from cancer causing toxins. The higher concentration of fiber in fenugreek influences its strength for glucose level tolerance. Galactomannan is an important soluble fiber of the fenugreek seeds; it diminishes the bile salts uptake in intestine andalso decreases the digestion and absorption of starch in body. It is also known for its higher occurrence of calcium, iron and zinc¹³. Fenugreek gum is originated from the endosperm of the seeds and it consists of mannose & galactose¹⁴.

Table 2: Physico-chemical constituents of T. foenum graecum seeds

Parameters :	Results/w :
Foreign matter	1.16
Loss on drying	12.62

Foaming index	259.95
Swelling index	10.5
Ash value	
Total ash	
Acid insoluble ash	3.3
Water soluble ash	0.4
	1.6
Extractive values	
Alcohol soluble extractive value	14.40
Water soluble extractive value	35.00

II . PHARMACOLOGY :

: *Antidiabetic activity*

The antidiabetic effect of fenugreek ethanolic extract (*Trigonella foenum-graecum* L) was investigated in normal and streptozotocin-induced diabetic rats. The antidiabetic effect of the extract was similar to that observed for glibenclamide¹⁵. The hypoglycemic activities of the aqueous extract of the seeds *Trigonella foenum-graecum* in normal mice using oral route of administration. The methanolic extract administered through the same route produced hypoglycemic effect only at the dose of 1g/kg body weight. The aqueous extract is under further investigation to determine the chemical structure of the active component. The presence of hypoglycemic activity in aqueous and methanolic extract indicates that the active compounds are polar in nature¹⁶. The beneficial effect of feeding fenugreek (*Trigonella foenum-graecum*) seed mucilage and spent turmeric (*Curcuma longa*) on diabetic status was studied in streptozotocin-induced diabetic rats. Fasting blood glucose showed a 26% and 18% improvement with fenugreek seed mucilage and spent turmeric feeding to diabetic rats, respectively. Fenugreek seed mucilage compared with turmeric was more effective in ameliorating diabetic state¹⁷.

The harmful side effects of synthetic drugs, the enormous cost and in the capacity of existing modern techniques to control all pathological aspects and the poor advance therapies for many rural populations in developing countries. Galactomannan, a soluble fiber is isolated from Canadian grown fenugreek seeds, responsible for reduction of postprandial blood glucose level. .

Because of its viscous property, galactomannan has ability to reduce intestinal absorption of high or low concentration of glucose, so that there is the benefit of blood glucose control¹⁸.

Antioxidant Activity:

Flavonoids of Fenugreek extract have been investigated to possess anti-oxidant activity⁴¹. In a latest study fenugreek seed extract has been reported to prevent lipid peroxidation and hemolysis in RBC. Fenugreek seeds have also been proved to raise the anti-oxidant levels and reduce the liver peroxidation in liver of diabetic rats¹⁹. The seed extract exhibited scavenging of hydroxyl radicals and inhibition of hydrogen peroxide-induced LPO in mitochondria of rat liver cells. The OH scavenging activity of the extract was demonstrated by pulse radiolysis and the deoxyribose system. The fenugreek seeds extract contains antioxidants and protects cellular structures from oxidative damage. An aqueous methanolic extract of fenugreek was investigated for its anti-radical and in vitro antioxidant activity in various model systems. The results gained by different methods provide some important factors responsible for the antioxidant activity of fenugreek seeds²⁰.

Hyperlipidemic Activities:

Atherosclerosis and its related abnormalities compose the mainly common cause of death in western or urban societies. A diet rich in fiber and vegetables has to reduce the atherogenesis. Inhibition of low density lipoprotein oxidation can diminish the risk of atherosclerosis independent of reducing plasma cholesterol levels²¹. The hypocholesterolemic properties of ethanol extract of fenugreek seeds were investigated. The experimental rats were administered 30 or 50g ethanol extract/kg of fenugreek seeds for one month. Approximately 18 to 26% reduction were seen in plasma cholesterol as well as liver cholesterol. The ethanol extract from fenugreek seeds contained hypocholesterolemic component, saponin that interact with bile salts in the digestive tract. The focus on the contribution of an ethanol extracts of fenugreek seeds in reducing cholesterol levels in hypocholesterolemic rats²².

IV. Traditional uses of Fenugreek :

As a functional food :

Fenugreek is well known for the principal source of soluble fiber in the plant. Dietary fiber is highly capable to reduce risk of cardiovascular abnormalities and some specific type of cancer due to the reduction of LDL level and total cholesterol²³. Researches investigated the physicochemical & nutritional properties of bread made from fenugreek flour supplemented with wheat flour²⁴.

Trigonelline, alkaloid of fenugreek can be used in the manufacture of imitation maple syrup and artificial flavoring for vanilla, butterscotch and rum²⁵.

As a traditional medicine :

Fenugreek is highly rich in phytochemicals such as flavonoids, steroids and alkaloids, which have been identified and isolated by the pharmaceutical companies or industries for the manufacture of hormonal and therapeutic drugs²⁶. The use of fenugreek seeds in eczema or other inflammatory situations is one of the more historical medicinal uses and the practice is still in use today in many countries. The extracted oil from fenugreek represents about 6-8% of the seed weight. It was also used as a tonic and treatment for weakness and edema of the legs²⁷.

As a forage crop :

Fenugreek was cultivated as a forage crop, from the ancient Greek period. In another study, fenugreek seed was added as a supplementary into a dairy cattle diet and was concluded to significantly improve the fatty acid profile in the milk produced. The study also confirmed that the fenugreek fed cattle had a 4% reduction in blood cholesterol concentration as well as 19% decrease in milk cholesterol level²⁸.

As a Anti-cataract

Cataract is the opacification in the eye lens and it remains the leading cause of visual abnormality, also contributes 50% of blindness worldwide²⁹. The anti-cataract potential of *Trigonella foenum graecum* was evaluated in selenite induced in vitro medium. The medium was supplemented with selenite and aqueous extract of *T. foenum graecum* to the test group. An increasing level of malondialdehyde and diminishing level of GSH were seen in control as compared to standard lenses. *T. foenum graecum* amazingly restored glutathione & decreased malondialdehyde levels. It also plays an important part in restoration in the anti-oxidant enzymes such as superoxide dismutase, glutathione, peroxidase, catalase and glutathione-S-transferase.

Fenugreek protects against the experimental cataract due to its anti-oxidant properties and also significantly restored the GSH level in a dose-dependent manner³⁰.

As a Anticarcinogenic

Trigonella foenum graecum seeds showed potential protective activity against 7, 12-dimethylbenz (a) anthracene-induced breast cancer in rats at 200mg/kg of body weight and the extract significantly inhibited the DMBA-induced mammary-hyperplasia and decreased its incidence. The ethanolic extract of fenugreek seeds with an ED50 less than 10µg/ml in the brine shrimp cytotoxicity assay, was also observed to possess anti-tumour activity in A-549 male lung

carcinoma, MCF-7 female breast cancer. Further studies concluded that fenugreek is a safe medicinal herb for complementary therapy in cancer patients because fenugreek extract shows a protective effect by modifying the cyclophosphamide induced apoptosis and lipid peroxidation in the urinary bladder of experimental mice³¹. Fenugreek contains a crystalline steroid sapogenin, Diosgenin as a starting material for the synthesis of steroid hormones such as cortisone and progesterone. It has the potential to prevent invasion, suppress proliferation and osteoclastogenesis through inhibition of necrosis factor and enhances apoptosis induced by cytokines and chemotherapeutic agents³².

Used for Antifertility

The antifertility effect was evaluated due to the addition of 30% fenugreek seeds to feeding diet of male and female rabbits and reported the following results: a) the circulation of plasma progesterone concentrations at 10 and 20 days of gestation significantly increased with no any side effect on the prebreeding estrogen concentrations. b) significant reduction of developing fetuses in the female rabbits. c) in the experimental animals the plasma concentration of the androgen hormone and sperm concentration were halved. d) toxicity effect in male rabbit. e) an antifertility effect of fenugreek seed in female rabbit. f) testis weight in male diminished with damage to the seminiferous tubules and interstitial tissues³³.

Used as Immunomodulatory

An agent that increases or reduces the immune responses is known as immunomodulator and such effect is immunomodulatory effect. Fenugreek in the diet showed a mark reduction in signs & symptoms of diabetes like polyuria, urine sugar, renal hypertrophy, excessive thirst and glomerular filtration rate³⁴. Aqueous extract of fenugreek was investigated to ameliorate additive urotoxicity of buthionine, sulfoximine and cyclophosphamide by restoring the anti-oxidant status and reversing the cyclophosphamide-induced cell death in free radical-mediated lipid peroxidation in the urinary bladder³⁵. To assess the immunomodulatory activity male albino mice were treated with three doses of aqueous extract of fenugreek 50, 100, 250 mg/kg of body weight respectively for 10 days. The increase in thymus weight was due to by an increase in cell counts. This may be due to the stimulatory effect of plant extract on the lymphocytes and bone marrow hematopoietic cells³⁶.

Used as Urotoxic

An anti-cancer drug Cyclophosphamide causes toxicity by its reactive metabolites acrolein and phosphoramidate mustard. Fenugreek showed protective effect on lipid peroxidation activity and enzymatic anti-oxidants. Animals that are treated by Cyclophosphamide drug showed a

significant decrease in the activities of glutathione S-transferase, glutathione reductase, glutathione peroxidase and catalase when compared to the control groups.

L-buthionine-SR-Sulfoximine treatment depicted an additive toxic effect in CP-treated animals.

The pretreatment of herbal extract showed an overall protective effect on additive effect of CP and BSO³⁷.

Non-insulin dependent diabetes mellitus

Hypoglycemic effect of Fenugreek seed powder (*Trigonella foenum-graecum*) was studied in 60 non-insulin dependent diabetic patients. Glycosylated hemoglobin measured at the end of the 8th week of fenugreek seed powder administration was reduced significantly ($p < 0.001$). This shows that feeding Fenugreek seed powder is beneficial to diabetic subjects³⁸. Fenugreek seeds (*Trigonella foenum-graecum*) show 64% reduction in 24 hr urinary glucose excretion with significant alterations in serum lipid profile. Serum total cholesterol, LDL and VLDL cholesterol and triglyceride levels decreased without any alteration in HDL cholesterol fraction with fenugreek diet³⁹.

V. CONCLUSION

Fenugreek is one of the supplements used to support non-insulin dependent diabetes mellitus. Fenugreek seed helps by not only reducing blood sugar levels due to its high concentrations of phytochemicals, but it has also helped reduce low density cholesterol. Fenugreek has an extensive variety of actions which are likely to protect human body against a number of abnormalities. In spite of various actions of *Trigonella foenum-graecum* on chronic disorders, the relevant clinical applications and mechanism of action is still to be the area of research. In this review article, various activities like antidiabetic, antioxidant, anticarcinogenic, antiulcer, antifertility, immunomodulatory and many more discussed last three decades. High fiber, protein content and other bioactive compounds make it a naturally several health promoting herb.

Anti-cataract effect of this plant is a significant pharmacological activity, which should be focused more in the future.

T. foenum-graecum and *Z. officinale* are consumed as traditional medicinal plants worldwide and are also used as phytomedicine for the treatment of infectious diseases and bacterial infections, having numerous medicinal properties. The comparative analysis of *T. foenum-graecum* and *Z. officinale* showed that *Z. officinale* showed higher therapeutic effects due to the presence of quercetin, gallic acid, caffeic acid, vanillic acid, syringic acid, cumeric acid, benzoic acid, chlorogenic acid, p-Coumaric acid, ferulic acid, and cinnamic acid. This research laid the foundation for the discovery of optimized, cost-effective in vitro bioassays of active constituents of different plants. *T. foenum-graecum* and *Z. officinale* could be used as nutraceutical adjuncts as

they have immense prospects to be further explored in animal and human trials. Furthermore, these medicinal plants are potential sources of significant natural antioxidant and marked antimicrobial agents. Furthermore, isolation, purification, and investigations of the bioactive constituents of these plants are required to reveal more health benefits for the public and therapeutics uses in the medical field.

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