



International Journal of Medicine and Pharmaceutical Research

Journal Home Page: www.pharmaresearchlibrary.com/ijmpr



REVIEW ARTICLE

A Review on Pharmacognostical and Pharmacological Activities of *Trigonella Foenum-Graecium*

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ABSTRACT

Fenugreek (*Trigonella foenum-graecum*) is a medicinal plant with potential applications in the medicinal purposes. Fenugreek has been used in food as a flavouring agent since ancient times in many countries like Greece, Rome and Egypt. It has a special place in the traditional medical system. The seeds are rich sources of lipids, protein, mucilage, calcium, dietary fiber B vitamins, Iron, protease inhibitors and several steroid saponins, tiny amounts of alkaloid, furostanol glycosides and steroidal peptide. It has the ability to act as anti obesity, antibacterial, anti-ulcer, anti-cancer, anthelmintic (antagonistic effect against parasitic worms), and antinociceptive (pain-reducing) properties. In recent years, laboratory studies and clinical trials have focused on the potential activity of fenugreek as a natural medicine. The aim of the present review is to provide detailed information about pharmacognostical and pharmacological activities of fenugreek

Keywords: Fenugreek, pharmacognostical and pharmacological activities, hypolipidemic

ARTICLE INFO

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PAPER-QR CODE

ARTICLE HISTORY: Received 14 February 2018, Accepted 11 March 2019, Available Online 10 April 2019

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Citation: T. Usha Kiran Reddy, et al. Review on Current trends in personalized medicines Author. *Int. J. Med. Pharm. Res.*, 2019, 7(2): 56-61.

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1. Introduction

Fenugreek (*Trigonella foenum-graecum* L.) is annual plant from Fabaceae family, which is native to the Indian subcontinent and the Eastern Mediterranean region¹. Fenugreek, is known for the presence of distinctive aromatic compounds that gives special a flavour and

colour to the food². Fresh fenugreek leaves are considered as an ingredient in some Indian Curry³. It is one of the most ancient medicinal herbs. It provides natural food fibre and other nutrients required in human body⁴. Fenugreek is one of the oldest known medicinal plants

which has been documented in ancient herbal history. Seeds of the fenugreek have been used as a holy smoke that Egyptians consumed in their embalming rites during Pharaohs time⁵. It has been used also to promote labour before delivery during Greek period⁶. According to Chinese traditional medicine, fenugreek can be used to treat Lymphedema (oedema of the legs)⁷. Fenugreek seed is a good source of calcium, minerals, iron, β -carotene and several vitamins like A and D. It is rich source of available carbohydrates and dietary fiber⁸. It is a source of free amino acids; 4-hydroxyisoleucine, lysine, histidine and arginine (25.8%), protein (20-30%), moisture (11.76%), fat (6.53%), crude fibre (6.28%), ash content (3.26%) and energy (394.46 Kcal/100 g seed)⁹. It contains lecithin, choline, minerals, B. Complex, Phosphates, and Para-Amino Benzoic acid (PABA). Apart from main chemical compounds present in fenugreek, there are other constituents such as saponins, fenugreekine, trigonelline, coumarin, scopoletin, phytic acid and nicotinic acid¹⁰. The significance of *T. foenum-graecum* seeds is due to the defatted part, with high quality fibre including steroidal saponins and protein comparable to those of soybean¹¹. The seeds also have the alkaloid trigonelline with mucilage, tannic acid, a yellow colour substance, fixed and volatile oils and a bitter extractive, diosgenin and gitogenin, a trace of trigogenin¹². The main bioactive compounds in fenugreek are Galactomannan, Diosgenin, 4-Hydroxyisoleucine¹³.



Kingdom	Plantae
Clade	Angiosperms
Order	Fabales
Family	Fabaceae
Genus	Trigonella
Species	<i>T. foenum-graecum</i>

Pharmacognostical Activities:

Earlier workers have reported that seeds possess, antidiabetic and wound healing activities Chauhan et al 2010¹⁴; Shah and Seth 2010¹⁵. The key obstacles which has hindered the acceptance of the alternative medicines in the developing countries is the lack of documentation and stringent quality control. There is a need for documentation of research work carried out on traditional medicines, hence it becomes extremely important to make an effort towards standardization of the plant material to be used as medicine. Hence this work attempts to bring out the pharmacognostic features of leaves and stem of *Trigonella foenum-graecum*.

2. Materials and Methods

Microscopic Characters: For microscopic studies, the leaves were cut and removed from the plant and fixed in FAA. After 24 hours of fixation, the epidermal peel and transverse sections of leaf were taken by free hand. The section were stained in safrain (1%) and mounted in glycerol.

Quantitative Microscopic:

The total number of stomata was calculated by stomatal index = No. of stomata X 100/ total no. of epidermal cells. The type of the stomata, vein islet and vein termination was recorded in the epidermal peeling. Quantitative microscopy was studied as per the procedure given by Wallis¹⁶ 1958 and Lala 1981¹⁷. The total no of stomata in the epidermal peelings, vein islet no., vein termination no. were recorded. *Trigonella foenum graecum* showed 39.82% of stomatal index, No of stomata-92, vein islet no 19-30/ sqmm, vein termination no 16-22- /sqmm. The stomata was observed to be anisocytic with 3 subsidiary cells surrounding the guard cell.

Organoleptic Characters and Anatomical Study:

Organoleptic:

Characterization of dried leaf powder was carried out. The texture, smell, colour and taste was observed. Free hand section of Leaves and Stems of *Trigonella foenum graecum* were taken, stained with Safranin and mounted in glycerol and observed under light microscope and photographed at 40x. The study showed that *Trigonella foenum graecum* dried leaves were Dull Green, brittle, aromatic, bitter, and astringent.

Maceration:

The stems of *Trigonella foenum graecum* were cut into small piece, boiled in water and cooled. The cooled material was repeatedly boiled to expel air and repeated for 3-5 times until the pieces settled down. Treated pieces of the plants was soaked in jeffreys fluid (equal volume of 10% of nitric acid and 10 % chromic acid) for 24 hours at 30-40°C, decanted washed and then stored in 50% alcohol. Pieces of macerated stem was treated with aqueous safranin overnight, dehydrated through alcohol series (50%,60%,70%,80%,90%,100%) for five minutes and passed through alcohol: xylol (1:1 ration) series for five minutes. Then each material was macerated and observed. The macerated stem of the plant showed various structures. In *Trigonella foenum graecum* xylem fibers, tracheids with scalariform thickening was commonly observed

Histochemical Test:

The plant section treated with various reagent such as Wagner's reagent (Potassium iodide and Iodine) for detection of alkaloid, Toluidine blue 0 for lignin, Ferric chloride in IN Hydrochloric acid for Tannin, Sulphuric acid for detection of calcium oxalate Crystals and Methylene blue for phenols. The histochemical studies showed the presence, alkaloids, protein, starch, lignin, mucilage and phenol; tannin and lipids were absent.

Phytochemical Screening:

The leaves and stem were washed thoroughly, blotted dry and completely dried. The dried leaves were extracted with aqueous, petroleum ether and Dichloromethane. The

extracts were used for the following phytochemical tests. Chemical tests for various extracts were also carried out according to the standard procedures described by Harborne 1998¹⁸; Kokate 1986¹⁹.

The preliminary analysis of leaf and stem aqueous, petroleum ether and dichloromethane extract showed the presence of Alkaloids, flavonoids, tannin, saponin, resin and steroid was recorded. Alkaloids were present in all the three extract, while tannin was present only in dichloromethane extract. Summaya et al., 2012²⁰ reported that absence of phenol in the leaf and stem extracts. It was reported that phenol are abundantly present in seeds only. Aqueous extracts showed presence of saponins. Singh et al., 2010²¹ Presence of high ascorbic acid and total phenol was reported by. Phenolic acids like caffeic acid, ferulic acid, vanillic acid and flavonoid are responsible for the antioxidant activity. Protein and carbohydrate content was reported to increase in mature leaf and stem. In present study presence of protein and carbohydrates was not observed in aqueous extract

3. Powder Analysis

The dried leaves and stems were powdered and sieved to obtain coarse powder. The powder thus obtained was placed on to a clean slide and observed under microscope. Resins, Bradyscleride, Macroscleride, Tracheids with scalariform thickening, calcium oxalate crystal, anisocytic stomata with subsidiary cells, epidermal cell were present.

Fluorescence Analysis:

The dry powder was placed on a slide and treating with several drops of specified reagent like Hydrochloric acid, Sodium hydroxide, Nitric acid, Sulphuric acid, Ferric chloride, Iodine Acetic acid, HNO₃+ Ammonia, Methanol, Sodium Hydroxide, Methanol. The slides were observed under UV 265 nm and 365 nm and the emitted fluorescence was observed that helps in identifying the drug in powdered sample. Fluorescence analysis has been carried out according to the method of Kokoshi et al., 1958²². Under white light, leaf powder with Hydrochloric acid, sodium hydroxide, nitric acid, sulphuric acid, ferric chloride, Iodine, Acetic acid, HNO₃, Ammonia, methanol, sodium hydroxide + Methanol showed brownish green, green, yellowish red, blackish brown, black, reddish brown respectively. Under UV light 265 nm it exhibited yellowish with NaOH, reddish with NaOH+Methanol. Fluorescence was observed in 365nm and it appeared bluish green with HNO₃+ ammonia, and NaOH+ Methanol

Physical Parameters: Determination of total ash, acid Insoluble ash, water soluble ash and moisture content was done according to Indian Pharmacopoeia 1985; 1996; 1998²³; Kokate 1986¹⁹

Qualitative Analysis:

Analysis of physical parameters of leaf and stem powder, the moisture content was 5.3%, water insoluble ash 10.9%, acid insoluble ash 0.61% and total ash 22.77%. It was reported that analysis of seed powder revealed moisture content was 1.5% whereas acid insoluble ash was 0.44% and the soluble extract 35 % w/w.

Pharmacological Activities Antidiabetic Activity

Eidi A and Mousa S investigated the antidiabetic effect of fenugreek ethanolic extract (*Trigonella foenum-graecum* L) in normal and streptozotocin-induced diabetic rats. The antidiabetic effect of the extract was similar to that observed for glibenclamide. The hypoglycemic activities of the aqueous extract of the seeds of *Trigonella foenum-graecum* in normal mice using oral route of administration²⁴. 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 nature²⁵. 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 activity²⁶.

Antifertility Activity

Zia et al., 2002 studied the antifertility effect of fenugreek seeds in female and male rabbits. The plasma concentration of the androgen hormone and sperm concentrations were halved in the treated animals. In the case of the females, there was evidence of a significant reduction of developing fetuses as observed by reductions of both fetal and placental weights at 20 days of gestation and of the litter size. This was further supported histopathologically by the observed proliferative changes of the endometrial glands. The circulating plasma progesterone concentrations at 10 and 20 days of gestation significantly increased with no significant effect on the prebreeding estrogen concentrations in the treated animals²⁷.

Hypocholesterolemic Effect

Guy V et al., 1993 reported the hypocholesterolemic activity in dogs. Fractions of fenugreek seed were added to the diet of normal or diabetic hypercholesterolaemia dogs for 8 days. The effects on levels of blood glucose, plasma glucagon and plasma cholesterol were investigated. The defatted fraction was rich in fibers (53.9%) and steroid saponin (4.8%) significantly lowered plasma glucose and cholesterol level in dogs²⁸.

Immunomodulatory Activity

Hafeez B et al., 2003 reported the Immunomodulatory activity of aqueous extract of *Trigonella foenum-graecum* L., a widely used medicinal and dietary herb, was evaluated in male Swiss albino mice. The 100 mg dose of *T. foenum-graecum* showed a stimulatory effect on immune functions in mice. As it is used for a variety of medicinal purposes, its immunostimulatory effect, as reported in this study, strengthens the rationale of its use in several Ayurvedic and Unani drugs²⁹.

Antiulcer Activity

Pandian SR et al., 2002 studied the effect of fenugreek seeds (*Trigonella foenum-graecum*) compared to

omeprazole was studied on ethanol-induced gastric ulcer. The aqueous extract and a gel fraction isolated from the seeds showed significant ulcer protective effects. The fenugreek seeds also prevented the rise in lipid peroxidation induced by ethanol presumably by enhancing antioxidant potential of the gastric mucosa thereby lowering mucosal injury. Histological studies revealed that the soluble gel fraction derived from the seeds was more effective than omeprazole in preventing lesion formation. These observations show that fenugreek seeds possess antiulcer potential³⁰.

Antioxidant Activity

McCarty et al.,2001 studied the anti oxidant effect in comparative study of antioxidant potential for previously identified optimum levels along with fenugreek (FGK) were evaluated in raw and cooked patties manufactured from frozen pork. The FGK (0.01%) showed most effective antioxidant effect with significant reduction with third position in descending order on 9th day³⁵⁻³⁶.

Fibrinogen and Fibrinolytic Activity

Bordia A et al.,1997 studied the fibrinolytic activity in a placebo-controlled study the effect of ginger and fenugreek was examined on blood lipids, blood sugar, platelet aggregation, fibrinogen and fibrinolytic activity. Fenugreek in dose of 2.5 gm twice daily for 3 month administration did not affect platelet aggregation, fibrinolytic activity and fibrinogen³³.

Antifungal Activity

Montagner demonstrated that coumarin, a constituent of *T.foenum- graecum*, has antifungal activity³⁴. Again,Yang CR et al.,2006 proved another in-vivo study the antifungal activity of saponin³⁵. Dharajiya D et al.,2016 showed that methanol extraction of *T. foenum- graecum* leaves powder had been shown to provide maximum antifungal activity against trichoderma viridae (ZOI = 14.5 ± 0.5mm) at the dose of 100 mg/ml³⁶. Again,Einour MEM et al.,2015 *T.foenum-graecum* seeds had been proved to possess the antifungal activity against *Aspergillus niger* (ZOI = 20 ± 0.88 mm) and *Candida albicans* (ZOI = 17 ± 0.57mm) while treated with petroleum ether extract and here the concentration was 250 mg/ml³⁷. Again, Haouala proved that methanol extraction of not ground seeds of *T. foenum- graecum* showed the strongest antifungal inhibition (71.44%) at the dose of 3g/100 ml³⁸.

Antibacterial Activity

Priya et.al, stated that *Trigonella foenum-graceum* have many essential phytochemicals such as Aziridine, 1, 2,3-trimethyl-, trans-, that may show antimicrobial activity³⁹. Again, some alkaloid components like jentianine and scopoletin are isolated from *T. foenum-graceum* seeds which have antibacterial activity. Patil S and Jain G demonstrated that scopoletin has bacteriostatic activity against *Escherichia coli*, *Staphylococcus aureus*, *Streptococcus* sp., *Klebsiella pneumoniae* and *Pseudomonas aeruginosa*⁴⁰. However, *T.foenum- graecum* seeds had been shown to decrease the activity against *E.coli* (ZOI = 17 ± 0.33 mm) and *Staphylococcus aureus* (ZOI = 15 ± 0.57 mm) while treated with petroleum ether extract and here the concentration was 250 mg/ml. Again,

at the dose of 100 mg/ml the aqueous extraction of *T. foenum- graecum* leaves showed antibacterial activity against *Serratia Marcescens* (ZOI = 12.33 ± 0.57 mm) and *Bacillus cereus* (ZOI = 11.50 ± 0.50 mm).

Analgesic and Anti-Inflammatory Activities

Vyas S et al.,2008 examined the Analgesic and anti-inflammatory effects in a partially purified fraction (MTH) of the *Trigonella foenum-graecum* seed extract. MTH at the dose of 40 mg/kg has shown significant analgesic activity (p<0.001) as compared to diclofenac sodium and pentazocine at the doses employed. In comparison to control, MTH at the employed doses

4. Conclusion

Natural products show a valuable and significant role in the health of the human being with or without marginally producing any undesirable effects likes side effects and adverse effects. They are usually the combination of the primary and secondary plant metabolites like alkaloids, flavonoids, glycosides, saponines etc.,and deliver the health protective and disease curing action. *T.foenum-graecum* is one of the natural gifts for us due to their phytochemical constituents which take part in different health related activities. It contains some significant alkaloids like trigonelline, gentianine; amino acids ; saponins like diosgenin, fenugreekine; and flavonoids like quercetin, vitexin, luteolin, homoerietin, isovitexin, saponarin, vicenin-1 and vicenin-2. *T. foenum-graecum* is used for the treatment of diabetes, oxidative stress, cancer, ulcer, allergy, bacterial, viral infection, fungal, malaria and inflammation etc. It is also used as antioxidant,hypolipidemic agent, breast enlarging agent,immunomodulator, anti-fertility agent, anti-inflammatory, analgesic and antipyretic agent. Clinical application of fenugreek is useful for present in addition to future but because of loss of focusing on research and clinical trials, all actions are not reported for human complications. Research on these seeds is going to give an explanation of its use in different types of cancer and other diseases/disorders. The present review shows that the plant possesses a wide variety of uses in preventing and curing various diseases.

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