

International Journal of Current Microbiology and Applied Sciences ISSN: 2319-7706 Volume 8 Number 11 (2019) Journal homepage: <u>http://www.ijcmas.com</u>



https://doi.org/10.20546/ijcmas.2019.811.313

Medicinal Activities of Trigonella-foenum-graecum (Fenugreek) – A Review

A. Akhila¹ and E. Keshamma^{2*}

¹Department of Zoology and Genetics, Government Science College, Nrupathunga Road, Bengaluru, Karnataka, India ²Department of Biochemistry, Maharani Science College for Women, Palace Road, Bengaluru, Karnataka, India

*Corresponding author

ABSTRACT

Keywords

Fenugreek, Trigonella foenum graceum, Methi, Medicinal uses

Article Info

Accepted: 04 October 2019 Available Online: 10 November 2019 Globally a large number of people are affected by acute and chronic diseases resulting in high morbidity and mortality rate. A huge amount of pharmaceutical drugs are being manufactured on a daily basis to combat these diseases. But due to their high cost and deleterious effects, it becomes critically important to state emphasis on finding an alternative way to manage these long term conditions. Medicinal herbs could provide a good source of dietary supplement combined with existing therapies. Many scientific studies have demonstrated that medicinal plants and herbs have the potential for the treatment of many serious infections and many disorders. Out of these herbs, Trigonella foenum-graceum (Fenugreek) is recognized as an oldest herb with great medicinal potential. Trigonella foenum-graceum L with leaves consisting of 3 small obovate to oblong leaflets is an annual herbaceous plant of the Fabaceae family. It is native to the eastern Mediterranean but is cultivated worldwide. This plant has medicinal alkaloids, steroid compounds, and sapogenins and many uses have been mentioned for this plant in traditional medicine. Many studies have been performed on the therapeutic effects and identification of chemical compounds of this plant. Its seeds are rich sources of protein dietary fiber, B vitamins, iron and several other dietary minerals. It has many potential medicinal applications in the health industry. Hence, in this narrative review of literature we aimed to describe and delineate on most important medicinal activities of Trigonella-foenum-graecum (Fenugreek).

Introduction

India is a land full of diverse flora and fauna collectively referred to as Biota. India has a huge diversity of flora owing to its vast range of topology, climatic conditions as well as habitat. Flora has been regarded as a source of medicine since ages. Around 8,000 species in India have medicinal value. Out of these, *Trigonella-foenum-graecum* (Fenugreek) is of great importance. Fenugreek is an annual aromatic plant grown throughout the Indian subcontinent (The ayurvedic pharmacopoeia of India). The seeds and leaves of Fenugreek has antioxidant properties. Fenugreek is native to southern Europe and the Mediterranean region and India is regarded as largest exporter of Fenugreek throughout the world. In India, Rajasthan produces around 80% fenugreek of the country. Fenugreek is also globally known to be cultivated in specific parts of North Africa, Pakistan, Iran. Afghanistan, Russia, Australia, the USA, Argentina, Canada, Spain, Turkey, Nepal, Morocco, and Lebanon (Im and Maliakel, 2008; Acharya et al., 2006). It has been grown for centuries across the Indian subcontinent. The plant has its traditional roots in Ayurvedic medicines. The Binomial name of Fenugreek is T.foenum graceum belonging to family Fabaceae and subfamily Papilionaceae (Figure 1). The genus Trigonella is derived from Greek word meaning 'three angled' and the Latin word foenum-graecum meaning 'Greek hay'. Fenugreek seeds have diverse uses such antibacterial, anti-inflammatory, as galactogauge, rejuvenating effects (Im and Maliakel, 2008).

Fenugreek is traditionally used for diabetes, painful menstruation, polycystic ovarv syndrome and obesity. Various parts of fenugreek such as stem, leaves and seeds contain active constituents that are of great medicinal importance. Fenugreek seeds are aromatic seeds used as seasoning especially in Many modern researches curry. have established the role of fenugreek seeds and leaves in the treatment of several diseases comprising reduction of blood cholesterol and sugar levels in both clinical and non-clinical trials (Acharya et al., 2006). In India, Fenugreek is popularly known as Methi (Figure 2). Many species of Fenugreek like T. balansae, T. carniculata, T. spicata, T. occulta, T. polycerata, T. calliceras, etc... are all great importance and cultivated globally (Basu, 2006). As Thomas Edison quoted "The

doctor of the future will no longer treat the human frame with drugs, but rather will cure and prevent disease with nutrition"; Fenugreek has been used worldwide as a part of our dayto-day life with respect to healthy nutrition.

Recently, there is an increasing tendency toward traditional medicine due to occurrence of harmful effects of chemical drugs on human health and various deficits of the modern medicine in treating some diseases. Medicinal plants have a long history of usage with low side effects. Recent studies have shown promising results for these plants in prevention and treatment of a wide variety of diseases such as diabetes, hypertension, atherosclerosis, cardiovascular disease, and cancer. Medicinal plants have also the capacities to diminish drug-induced adverse effects (Amini et al., 2012; Nasri et al., 2013) and even heavy metals or other toxicities Rafieian-Kopaei, (Heidarian and 2013; Heidarian et al., 2013). Therefore, they might be considered as reliable sources for development of new drugs.

One of the medicinal plants that has been used since antiquity in the traditional medicine for which significant therapeutic properties have been mentioned is fenugreek. The seed and aerial parts of the plant have been used for centuries as a valuable source of protein in man and animal's nutrition, and in the traditional medicine for various conditions.

The interesting point about fenugreek is the broad range of its therapeutic effects, including relief. antidiabetic, pain antiatherosclerosis, anti-inflammation, carminative. antispasmodic, laxative. increasing, anticancer. sexual desire astringent, heart tonic, laxative, hypertension decreasing, triglyceride lowering, breast milk increasing, and oxytocic properties are reported for this plant (Salehi Surmaghi, 2008).

This plant has medicinal alkaloids, steroid compounds, and sapogenins and many uses have been mentioned for this plant in traditional medicine (Salehi Surmaghi, 2008). This plant has been used to ease childbirth, to aid digestion, and as a general tonic to improve metabolism. Trigonelline is considered as the most important metabolite of fenugreek, which is effective in treating diabetes and decreasing blood cholesterol.

Trigonelline as a plant hormone is also used for cancer (liver cancer and cervical cancer) migraine. Studying the effect and of trigonelline on mice shows that this substance acts as sedative. This metabolite results from niacin that is one of the food and medicinal supplement vitamins and is generally used to reduce blood lipid and sugar (Basch et al., 2003). Many studies have been performed on therapeutic effects and identification of chemical compounds of this plant. In this narrative review of literature, we aimed to describe and delineate on most important medicinal activities of Trigonella-foenumgraecum (Fenugreek).

Origin and Distribution

This plant is indigenous to the eastern coasts of the Mediterranean and North Africa. According to some experts and scholars, this plant primarily was indigenous to Iran and then was transferred to other areas. Fenugreek is widely grown in India, China, Africa, Algeria, Saudi Arabia, Pakistan, Egypt, Turkey, Ukraine, Spain, and Italy. This plant is frequently exported from India, China, Turkey, and Morocco (Salehi Surmaghi, 2008). More than a hundred of wild and cultivated species of Fenugreek have been identified in the world. According to Iranica Flora, distribution of more than 32 species of this plant has been reported in many areas of Iran, including Azerbaijan, Isfahan, Fars, Khorasan, Semnan, Damghan, and central regions.

Medicinal Properties

In many experiments and trials including human and animals like mice, rat, dog it was reported that fenugreek seed lowers fasting serum glucose. The randomized controlled study of fenugreek seeds reported by Gupta et al., (2010) revealed that fenugreek seeds play pivotal role hypoglycemic regulation or control (Gupta et al., 2010). The study suggested that the fenugreek does not offer many differences in glucose level of people with fenugreek rich diet and people with exercise on daily basis. It was shown that fenugreek and exercise both are equally effective in reducing the blood serum glucose level and it may be an effective strategy to control type-2 diabetes mellitus. In a study it was found that the fenugreek treated patients showed a significant improvement and glucose tolerance test scores and serumclearance rates of glucose. Hypolipidemic effects of fenugreek seed showed lower serum triglycerides, total cholesterol and low-density lipoprotein cholesterol which may be due to sapogenins, which increase biliary cholesterol excretion and lower serum cholesterol levels.

Fenugreek is considered a multipurpose crop. From maintaining the blood glucose level to having anti-bacterial and anti-fungal effects, fenugreek is critically important for keeping a healthy digestive system. Fenugreek had diverse ethno-historical uses. Traditionally, fenugreek was used as a potent aphrodisiac to increase sexual desire and performance. Fenugreek was also used by Egyptian women to lessen menstrual pain and stomach problems (Morcos et al., 1981). Fenugreek seeds were considered as a hypoglycemic agent in Egyptian folk medicine. In Chinese medicine system, fenugreek was used as a tonic and to treat leg frailty and edema (Yoshikawa et al., 2000). Fenugreek was recognized as a main component for treating postmenopausal dysmenorrheal and

symptoms. In folk medicines, fenugreek was used for the treatment of tuberculosis and boils. The seeds of fenugreek were also used as an herbal remedy for constipation and diarrhea (Sharma et al., 1996; Sharma et al., 1996). The alcoholic extract of fenugreek was used to expel unwanted harmful material or poisons from the human body. Presently, fenugreek is used for diverse purposes across the globe such as for preparing flavor cleanse in Switzerland, spice in Iran, as vegetables in India and Pakistan and seed powder along with flour for making flat bread in Egypt (Zandi et al., 2011). Fenugreek have well established role in treating various animal and human disorders (Bunney, 1984). For instance the seed of fenugreek was used to enhance milk production (Sharma et al., 1991) and lower serum cholesterol level in animals (Doshi et al., 2001). Fenugreek is also used as food preservative in pickles as well as sauces. A well-known advantage of fenugreek is that it enhances blood hemoglobin level through natural means. This could help manage anaemia and lead a long and healthy life (Kirtikar and Basu). The seeds of fenugreek is used as a tonic and carminative as well as in several conditions like to treat dyspepsia, to cure skin conditions (wounds, psoriasis, rashes), treatment of reproductive disorders, gout, chronic cough, heavy metal toxicity and in rheumatism (Kirtikar and Basu; Prajapati et al., 2003).

Anti-diabetic

Fenugreek seeds have antidiabetic effect by increasing gastric emptying time and glucose absorption rate. Fenugreek seeds have greater quantity of fiber which reduces glucose uptake in small intestine also increase serum insulin level. Galactomannan, reduces postprandial blood glucose level. Fenugreek seed powder treatment for 21 days to diabetic rats brought down the high fasting blood glucose levels to control levels. The enzyme activities were restored to control values in both the kidney and liver. Fenugreek seeds have saponins and fiber content which are responsible for its antidiabetic property. The effect of oral administration of 5 % powder of fenugreek seeds along with diet in alloxan-induced diabetic rats for 21 days were investigated, the glycolytic, NADP linked lipogenic and gluconeogenic enzymes were determined in the kidney and liver tissues of rats. The fenugreek fraction significantly saponin modulated the enzyme glycogen and disaccharidase activities in the intestine, it suppressed the increase of blood sugar level, increased the hepatic glycogen content and improved results in the oral glucose tolerance test (Madan Vinod et al., 2012; Kritikar and Basu, 2005; Sharma, 2003). According to the recent study oral administration of diosgenin to diabetic rats for fourty five days shows a reduction in hyperglycemic condition and also an increase in insulin levels (Saravanan et al., 2014). Hydroalcholic extracts of fenugreek seeds at different doses was shown to produce increased body weight and glucose uptake, reduced plasma glucose, glycosylated hemoglobin (HbA1C) (Joshi et al., 2015).

Anti-oxidant

The phenolic compounds present in the fenugreek seeds are mainly responsible for antioxidant activity (Kaviarasan et al., 2007; Anuradha and Ravikumar, 2001). Various pharmacological experiments have been conducted by researchers to elucidate the antioxidant effect of Fenugreek. Kaviarasan et al., (2007) demonstrated the antioxidant activity of fenugreek seeds on rat liver and concluded that methanolic extract of fenugreek seeds was able to scavenge the free radicals (Kaviarasan et al., 2007). In another study it is indicated that phenolic compound showed the protective effect of fenugreek seeds. The activities of antioxidant enzymes were increased and thiol groups were restored (Kaviarasan et al., 2007,

2009). Annida et al., (2005) concluded that admiration of fenugreek leaf powder to diabetic rats lowered lipid peroxidation at the same time elevated the antioxidant system (Annida et al., 2005). Xue et al., (2011) observed the antioxidant potential of aqueous extract of fenugreek seeds in reinstating kidney function of diabetic rats. These investigations elucidated the protective action of fenugreek extract by remarkably increasing the antioxidant enzyme activities in kidney of diabetic rats (Xue et al., 2011). Tripathi and Chandra (2009) conducted a similar study that concluded fenugreek significantly improved thiobarbituric acid reactive substances (TBARS) levels and antioxidant enzyme activities in various tissues such as kidney, liver, or heart enunciating antioxidant effect of fenugreek in diabetes induced oxidative stress (Tripathi and Chandra, 2009).

Anti-carcinogenic

Cancer is a serious health issue that concerns the entire world. Its treatment protocols depend on chemotherapy, radiotherapy, and surgical intervention (Huang *et al.*, 2014). Breast cancer stands out as one of the most threatening diseases to females around the world. Liver cancer is considered the third reason for disease mortality around the world.

According to recent study by WHO death with liver cancer in world (Lin et al., 2020). Fenugreek seed extract has shown anticancer activity through inhibition of more than half of the human breast cancer MCF 7 lines. Anticancer properties and proteomic profiles of fenugreek seeds and is prompted by the clinical profile of a case of primary CNS T cell lymphoma that responded to fenugreek treatment and resulted in tumours regression. Plant-based active components have demonstrated their potential to be used as acceptable and safe alternatives. with anticancer effects that have been thoroughly investigated. Animals and cell lines were used as the exploratory models of cancer in these endeavors, and the efficacy of fenugreek seeds against cancer was proven.(Tohidi *et al.*, 2017; Yadav and Baquer, 2014)

Anti-inflammatory

Studies revealed that with 0.5 mL/kg fenugreek seed petroleum ether extract treatment, there was 37% and 85% reductionin inflammation of the paw in carrageenan and formaldehyde-induced paw edema model studies conducted in experimental animals. In complete Freund's adjuvant -induced arthritis, a biphasic increase in paw volume followed by decrease was seen. There was 42.5% reduction in the weight of cotton pellets and significant reductions in the elevated SGPT and ALP activities in serum and liver of fenugreek seed petroleum ether extract treated rats (Pundarikakshudu et al., 2016). The inhibition of edemaby the plant extract at doses of 100 and 200 mg/kg were meaningfully different from the control group. This activity of the plant at doses of 100 and 200 was not meaningfully different from those of ibuprofen and dexamethasone. Amongst the prepared formulations of the plant, 3 and 5% creams of the fenugreek showed the most inhibition of edema (Sharififara et al., 2009). The functional food quality of fenugreek seeds by determining the lipid peroxidation (LPO) and cyclooxygenase enzyme (COX) inhibitory activities of their ethyl acetate, hexane, methanolic and water extracts was investigated. The extracts inhibited lipid peroxidation, cyclooxygenase enzyme -1 and cyclooxygenase enzyme -2. Moreover. isolates, without the saccharides, inhibited lipid peroxidation and cyclooxygenase enzyme -1 and -2 enzymes between the ranges of 8-89%, 4-51% and 15-70%, respectively, at 25 µg/ml (Liu et al., 2012).



Fig.1 Showing plant of *Trigonella-foenum-graecum*(Fenugreek)

Fig.2 Showing seeds of *Trigonella-foenum-graecum*(Fenugreek)



Anti-lipidemic

Fenugreek seeds have been shown to exhibit hypocholesterolemia effects, lowered serum cholesterol, triglyceride and low-density lipoprotein in hypercholesterolemia suffering patients and experimental models (Mathern *et al.*, 2009). In obesity suffering rats fenugreek consumption in diet reduced triglyceride accumulation in the liver while fecal bile acid and cholesterol excretion were increased by fenugreek administration (Rashmi and Rahul, 2011). This may be secondary to a reaction between the bile acids and fenugreek derived saponins causing the formation of micelles too large for the digestive tract to absorb. Study conducted by Praveen Kumar revealed that fenugreek seeds were responsible for hypolipidemic effects (Kumar *et al.*, 2014).

Antimicrobial activity

Microbiological tests have shown that fenugreek extracts are effective against a wide range of microorganisms in terms of preventing bacteria from growing (Aqil and Ahmad, 2003). Aqueous fenugreek preparations of the seeds exhibited antifungal properties (Haouala *et al.*, 2008). Fenugreek seed formulations are used to treat digestive disorders (Raju et al., 2004). Aqueous solutions and macerated fenugreek oils help prevent colon cancer by protecting the mucosa in ulcer illness (Pribac et al., 2009). There is difference between fenugreek's no hepatoprotective qualities (Miraldi et al., 2001). In Iran, eye conditions and gynaecological issues are treated with fenugreek leaves(Hassanzadeh Bashtian et al., 2013). The year 2005 fenugreek seeds contain an alkaloid called tripgonelline that has been shown to have neuroprotective properties (Tohda et al., 2005).

Gastroprotective

In a study of Pandian et al., (2002) use of fenugreek seed showed antiulcer effect. The consequence of the seeds of fenugreek is analogous to the medicine omeprazole that is used as the blocker of proton pump in the treatment of gastro-intestinal issues such as gastritis, gastroesophageal reflux disease, gastric ulceration, and duodenum ulceration. In a rat model in which gastric ulcer was induced by ethanol, the gel portion and aqueous extract from the seeds of fenugreek have effects on mucosal glycoproteins and anti-secretory action plays a protecting role against ulcer. Ethanol-induced mucosal injury and lipid peroxidation can be avoided by improving the prospective of the mucosa of gastric against oxidation by the fenugreek seed consumption.

Gastric lesion formation can be prevented by the soluble gel fraction of fenugreek and its results are better than omeprazole. Gastro protective and anti-secretory activities of fenugreek seeds are due to the presence of polysaccharides and flavonoids presence in the gel portion of fenugreek (Pandian *et al.*, 2002). By the work of many researchers on the antiulcer and anti-cholesterol gallstone influence of fenugreek in the recent years, it is proved that active compounds like flavonoids in aqueous extract, gel and seed of fenugreek have positive effect in these diseases.

Hepatoprotective

The protective effect of apolyphenolic extract of fenugreek seeds against ethanol (EtOH)induced toxicity was investigated in human Chang liver cells. EtOH treatment suppressed the growth of Chang liver cells and induced cytotoxicity, oxygen radical formation and mitochondrial dysfunction. Incubation of polyphenolic extract of fenugreek seeds along with EtOH significantly increased cell viability in a dose-dependent manner, caused a reduction in lactate dehydrogenase leakage and normalized GSH/GSSG ratio. The findings suggest that the polyphenolic compounds of fenugreek seeds can be cytoprotective during EtOHconsidered induced liver damage (Kaviarasan et al., 2006). Extract of dried seeds of fenugreek on an animal model exhibits hepatoprotective activity revealed the presence of flavonoids (Meera et al., 2009).

Antiobesity

Ethanolic extract of fenugreek seed showed lower serum total cholesterol, triglyceride, LDL cholesterol and higher values of HDL cholesterol by decreasing the hepatic lipid content mediated by diosgenin, the main a glycon of fenugreek (Trigonella foenum Graecum, 2015). Many studies concluded that extract of fenugreek as supplement reduced the body weight and adipose tissue weight (Handa et al., 2005; Geetha et al., 2011). One such randomized placebo controlled trial study was conducted for 6 weeks on 39 overweight healthy male subjects given a fixed dose of extract of fenugreek seeds. It was noted that frequent administration of the extract resulted in reduced dietary fat consumption in the given subjects. The possible mechanism through which fenugreek acts is two fold.

Firstly, fenugreek expels the carbohydrate contents from the body just before it can enter the blood stream causing loss of weight, furthermore fenugreek has a significant amount of soluble fiber (around 40%) that basically slows down the digestion and absorption of carbohydrates from the intestine thus indirectly suppressing hunger and encouraging weight loss. The amino acid named 4-hydroxyisoleucine (0.015 % - 0.4 %) fenugreek reduces present in plasma triglyceride gain resulting in weight loss and prevention of obesity. In one of the experiments, it was observed that aqueous extract of fenugreek given to rats on high fat diet showed decrease in body weight and in body mass index (Singh et al., 2021).

Trigonella-foenum-graceum (Fenugreek) has significant medicinal properties and is used either alone or in combination with other drugs. It is an essential component of many compound formulations used in Unani medicine to treat a variety of illnesses. Because of its herbal nature and low risk of side effects, further study on fenugreek may result in the creation of medications with potential uses in the pharmaceutical and medical fields.

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How to cite this article:

Akhila, A. and Keshamma, E. 2019. Medicinal Activities of *Trigonella-foenum-graecum* (Fenugreek) – A Review. *Int.J.Curr.Microbiol.App.Sci.* 8(11): 2755-2765. doi: <u>https://doi.org/10.20546/ijcmas.2019.811.313</u>