



Review On Trigonella Foenum-Graecum (Fenugreek Seeds) With Pharmacological Activity

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ABSTRACT

Trigonella has been present on the continents of Asia, Europe, Africa, and Australia since prehistoric times. The species name "foenum-graecum" (meaning "Greek hay") suggests that it was once used as a feed crop. Traditionally, Trigonella foenum-graecum was used to cure a variety of illnesses. The biological and pharmacological effects of fenugreek, including its anti-diabetic, hypocholesterolemic, immunomodulatory, anti-toxic, anti-cataract, and antioxidant properties, were briefly reviewed in this study following a general discussion of its chemical constituents. The findings of these investigations offer a thorough comprehension of fenugreek's biological function.

KEYWORDS

Fenugreek, Trigonella foenum-graecum, Nutraceutical, Antidiabetic, Antioxidant,

INTRODUCTION

Spices are natural food additives that have been used to improve food's sensory appeal for thousands of years. Spices give meals their distinct flavor, aroma, color, and piquancy. Fenugreek is one of the spices that can change the texture of food. A leguminous herb, fenugreek (*Trigonella foenum-graecum*) is grown in North Africa and India. Various known as Fenugrec (French), Methi (Hindi), Bockshorkelee (German), Fienogreco (Italian), Pazhitnik (Russian), Alholva (Spanish), Koroha (Japanese), Hulba (Arabian), Halba (Malaya), and K'u-Tou (China), it is a member of the Fabaceae family. While the leaves are consumed as green leafy vegetables, the seeds are utilized as spices all over the world. The bitter-tasting seeds of fenugreek have long been used for their therapeutic properties. The use of fenugreek seeds dates back more than 2,500 years. India is the primary producer and consumer of fenugreek for both culinary and therapeutic applications.

Fenugreek seeds are used as a flavoring agent and spice for seasoning, and in relatively greater amounts, they are utilized to make pan cakes and soups. It works well as a stomach stimulant and against anorexia in India's traditional medical system. (1, 2) When planted in prepared soil, the seed sprouts in three days and develops into a sturdy, upright plant that is naturally resistant to most diseases and pests. It reaches a height of thirty to sixty centimeters and has compound pinnate trifoliate leaves, axillary white to yellowish flowers, and thin, pointed-beaked pods that are three to fifteen centimeters long and contain ten to twenty oblong, greenish-brown seeds with a distinctive hooplike groove. Being a leguminous plant, it enriches the soil by fixing nitrogen from the atmosphere. Greens are picked when they have three or four leaves, at which point their saponin content rises and they become bitterer. 30 to 35 days after flowering, or 155 to 165 days after seeding, the seeds are harvested. (3)

Its names and scientific classifications are as follows.

Taxonomy

Kingdom: Plant

Family: Fabaceae

Genus: Trigonella

Species: foenum-graecum

General name: Fenugreek

English name: Fenugreek

Arabic name: Hhulbah, Hhelbah

French name: Trigonelle, Senegrain, Foingrec

German name: Gemeiner, Hornklee, Bockshornklee

Indian name: Sagmethi, Methi, Kasurimethi

Italian name: Fienogreco, Erbamedica(4)

Name, Classification, and Plant Characteristics

Angiosperm Trigonella foenum-graecum is a member of the Legouminosae family, which is a subfamily of the Papilionaceae, the Rosaceae order, and the Trigonella L. genus, which is a member of the Trifolia group.(4)Because of the triangular shape of its leaflets, this plant's name is derived from the Greek word trigonou, which means triangle.Because foenum-graecum was widely used in ancient Greece, it is also known as "Greek hay" or Greek grass. Fenugreek is an annual herbaceous plant that can grow up to 50 cm in height.

The single stem of this plant is often glabrous, twisted, or has dispersed tomentums. The oval, serrated leaves are made up of three tiny, oblong to obovate leaflets that are dispersed from a single point. Insects pollinate the flowers, which are 0.8 to 1.8 cm in diameter and pale yellow to whitey purple in color. Fruits are curving pods that range in length from 3 to 11 cm. They contain 5 to 20 angled seeds that are 4 to 6 mm long. The seeds range in hue from pale yellow to brown and have a fragrant and bitter flavor.

Phytochemistry

Steroid sapogenins are among the several chemical components found in fenugreek. The oily fenugreek embryo has been shown to contain a diosgenin component. According to reports, fenugreek contains two furastanol glycosides, which are also known as hederagin glycosides and F-ring opening precursors of diosgenin. Stem contains alkaloids like trigocoumarin, nicotinic acid, trimethyl coumarin, and trigonelline.

One notable component of the seeds is the mucilage.The stem contains 22% proteins, a yellow coloring component, a volatile oil, two alkaloids like trigonelline and choline, 5% of a stronger-smelling, bitter fixed

oil, and roughly 28% mucilage.(6) Fenugreek has a protein content of 23–26%, a lipid content of 6–7%, and a carbohydrate content of 58%, of which approximately 25% is dietary fiber. Another excellent source of iron is fenugreek, which has 33 mg/100g dry weight.(7)

Leaves

Seven graecunins, or saponins, are found in the leaves. These substances are diosgenin glycosides. About 86.1% moisture, 4.4% protein, 0.9% fat, 1.5% minerals, 1.1% fiber, and 6% carbs are found in leaves. Calcium, zinc, iron, phosphorus, riboflavin, carotene, thiamine, niacin, and vitamin C are among the minerals and vitamins found in leaves.(8) Ascorbic acid levels in fresh fenugreek leaves are approximately 220.97 mg/100g, whereas b-carotene levels are approximately 19 mg/100g. Conversely, it was found that fenugreek leaves that were sun-dried had an 84.94% decrease in ascorbic acid and those that were oven-dried had an 83.79% decrease. The diets employ fresh leaves as veggies. In fenugreek leaves, it was discovered that nutrients were better retained. Fenugreek leaves should be kept refrigerated, dried in an oven, blanched for a few minutes (about five minutes), or cooked in a pressure cooker.(9)

Seed

The seeds of fenugreek are renowned for being mildly sweet and pleasantly bitter. The seeds, which can be pulverized or whole, are used to flavor a variety of meals, primarily teas, curry powders, and spice blends. A corneous, rather large coating of white, semi-transparent endosperm envelops the firm, yellow embryo at the center of fenugreek seeds. According to the chemical makeup of fenugreek (including the seeds, husk, and cotyledons), the endosperm contained the most protein (43.8g/100g) and saponin (4.63g/100g).(10)



Figure 1. Fenugreek leaves and seeds.

Plant Chemistry

The primary components of the seed are fibers (50%) mucilage, alkaloids, and steroidal saponins.(11)

Steroidal Saponins. The two most significant steroidal saponins (0.1% to 2.2%) are yamogenin and diosgenin (Figure 2). Sarsapogenin, yuccagenin, smilagenin, tigogenin, and gitogenin are other sapogenins. Fenugreekine, a sapogenin peptide ester, is also present in the seeds.(12)

Alkaloids. The plant's alkaloid, triphenelline, has been extracted in concentrations as high as 36%. The seed also contains carpaine choline and gentanin as alkaloids.(11)

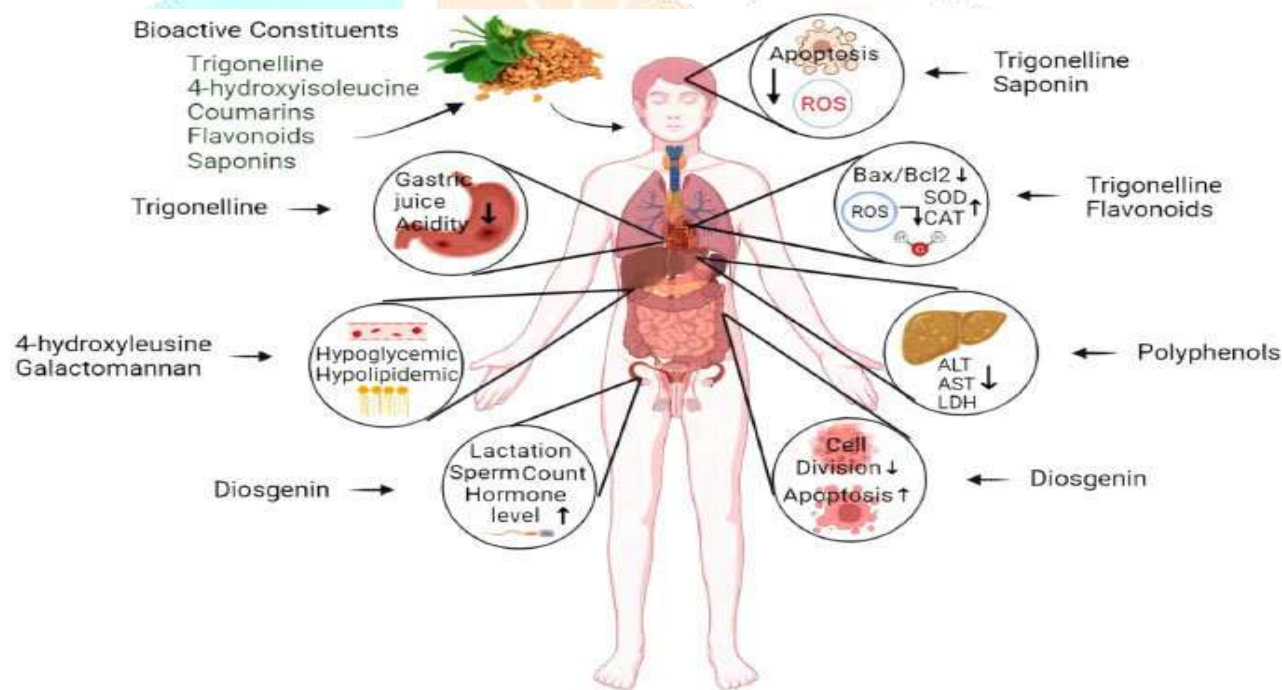
Oils. Fixed oil from fenugreek seeds contains 6% to 10% unsaturated fatty acids that are odorless and bright yellow. Petroleum ether, sulfur, benzene, and ether all readily dissolve oil. There is antibacterial action in fenugreek oil.(11)

Mucilage. The seed's endosperm contains mucilage molecules that, when hydrolyzed, provide mannose and galactose. In addition to being neutral, fenugreek includes xylene and galactomannan. The presence of mucilage in fenugreek seeds gives them their laxative properties. Fenugreek mucilage has the ability to retain water in contrast to sodium alginate. It has a good emulsifying and suspending action as well.(12)

Protein Compounds. Lysine, arginine, tryptophan, and to a lesser degree, histidine are all abundant in this plant's high protein content (22% to 25%). It has high concentrations of lysine, arginine, and gelicin and low concentrations of sulfur-containing amino acids, threonine, valin, and methionine.(13)

Carbohydrates. This plant has roughly 8% carbohydrates. Additionally, fenugreek seeds contain chemicals that hinder the production of proteins. They are also said to include vitamins B1, C, A, and D, as well as minerals including calcium, phosphorus, and iron.(11)

Impact of fenugreek seeds on a range of illnesses:



Antidiabetic activity

Diabetes mellitus, a chronic metabolic condition, is brought on by abnormalities in the metabolism of fats, proteins, and carbohydrates. Even though there are a number of pharmaceutical and injectable insulin therapy options, they all have drawbacks. Diabetes mellitus can be controlled by eating habits that are high in chemical components that will help to manage blood glucose levels and also provide a cost-effective strategy. Fenugreek is a well-researched herbal plant whose effects on diabetes have been extensively explored.(14) Seeds, leaves, and their extracts have been shown to be effective in the fight against diabetes. Streptozotocin was used to induce diabetes in rats, and the effects of fenugreek water seed extract were assessed by intragastric intubation at three different dose levels. In comparison to the group that received streptozotocin alone, it was shown that the mice treated with fenugreek gained weight. Furthermore, compared to the group that got streptozotocin alone, the blood glucose level dropped more significantly.

A different set of researchers discovered similar outcomes in their investigation, finding that rabbits supplemented with fenugreek had higher body weights than rabbits with diabetes induced by alloxan monohydrate. (15) Oral treatment of fenugreek seed powder decreased plasma glucose levels in both diabetic and nondiabetic rabbits. Histopathological examination of the pancreas of placebo controls revealed normal cytoplasm and acini in the islets of Langerhans. However, alloxan-induced diabetes resulted in reduced islet diameters and significant damage to the islets of Langerhans. It was discovered that fenugreek extract repaired the islets of Langerhans in diabetic rats.(16)

From the crude extract, an active ingredient that can help lower blood glucose levels can also be extracted. In one investigation, the GI was separated from the fenugreek seed aqueous extract. Fenugreek was a significant hypoglycemic agent even in Egyptian traditional medicine. The fenugreek extract was able to suppress α -amylase activity in a dose-dependent manner. By demonstrating suppression of starch digestion and absorption in normal rats, a subsequent in vivo investigation concluded and validated in vitro inhibition, indicating that the hypoglycemic impact of the employed plant extract was mediated by an insulin mimic action.(17)

Antigenotoxic activity

Some researchers have investigated fenugreek's antigenotoxic impact using plant systems. The *Allium* root chromosomal aberration assay is one of the most well-established methods for tracking gene-level toxicity. Toxic chromium trioxide was applied to onion root tip meristem cells. Chromosome aberration in *Allium cepa* roots decreased in a dose-dependent manner when fenugreek sprouts were extracted in methanol. Studies on the antimutagenic properties of fenugreek have also been conducted in microbiological systems. The mutagenic activity of direct-acting mutagens against *Salmonella typhimurium* was reduced by an aqueous extract of fenugreek seeds.(18)

Anti-Inflammatory activity

In several nations, including southern India, Iran, and African nations, fenugreek has long been used as a traditional medicine to treat inflammation and its associated side effects. The primary chemical components that have anti-inflammatory properties are flavonoids, alkaloids, and saponins.(19) The aqueous extract of fenugreek leaves and the chloroform fraction of seeds were found to be efficient against anti-inflammatory activities.(20)

Anti-diarrheal activity

When identifying herbs with antidiarrheal properties, fenugreek is crucial and helpful. The study assesses the anti-diarrheal properties of *Trigonella foenum-graecum* methanol and aqueous extracts.(21) According to the findings, TEG seed methanolic extract exhibits stronger anti-diarrheal properties than aqueous extract.(22)

Fenugreek in cancer therapy

A medicinal herb used to treat cancer patients undergoing chemotherapy is fenugreek. By altering the cyclophosphamide-induced apoptosis and free radical-mediated lipid peroxidation in the mouse bladder, fenugreek extract has a protective effect. It may play a significant role in the therapy of cancer [23]. The apoptotic properties of flavonoids and catechins were initially demonstrated in human cancer cells. In the H-29H human colon cancer cell line, diosgenin, which is found in fenugreek, inhibits cell proliferation and

induces apoptosis [24]. It was discovered that HFenugreek seed possesses hepatoprotective qualities. HPolyphenolic extract from fenugreek seeds functions as a preventive agent against irregularities brought on by ethanol. [25] HinH theHliver.

Use of fenugreek in arthritis

Estrogen-like substances have been shown to reduce tissue inflammation in rheumatoid arthritis, an autoimmune illness, by triggering pathways that reverse the effects of autoimmunity diseases by binding estrogen metabolites to DNA [26]. Because fenugreek mimics estrogen, it has been demonstrated to halt autoimmune diseases. By affecting genetic activities and triggering the development of estrogen-responsive proteins, Sreeja et al. discovered that fenugreek bound to estrogen receptors and functioned as estrogen [27]. It was suggested that the observed anti-arthritic action might be due to *T. foenum graecum* L.'s antioxidant and anti-inflammatory properties [28].

Fenugreek in obesity

One of the main risk factors for illness and death is obesity. Adipose tissue growth that is abnormal might be characterized as obesity. Supplementing with fenugreek seed extract has been shown by certain investigations to reduce body weight and adipose tissue weight. Weight reduction is likely caused by fenugreek's ability to drain away carbs from the body before they enter the bloodstream, which lowers body weight and adipose tissue weight. There is a significant amount of soluble fiber (40%) in fenugreek seeds. (29) In conclusion, fenugreek has antioxidant properties that preserve organs and limit the onset of diseases. It also reduces body fat and is helpful against obesity. This plant is also effective against blood lipids, sugar, and certain bacterial strains. (30)

Fenugreek in asthma treatment

One of the most common lung conditions is asthma, which causes inflammation of the bronchial tubes or airways, narrowing the airway for intake and exhalation. As a lung tonic and to aid in lung secretions, fenugreek helps the lungs function better. [31] According to many research, fenugreek's flavonoid content exhibits antioxidant properties by limiting lipid peroxidation and protecting the airways from oxidative stress. [32] Additionally, the flavonoids inhibit basophil and mast cell stimulation. [33] Additionally, fenugreek can lessen the harm caused by oxidative mediators. [34] Flavonoids can stop many stages of angiogenesis, including cell migration and the development of microcaillary tubules. [35] As previous studies have shown, vascular alterations play a major role in the pathophysiology of asthma. [36] The unique anti-inflammatory properties of fenugreek seeds have been verified. [37] Both IL4 were selected as Th2 profiles in atrophy and asthma issues to assess the relationship between cytokine imbalance (Th1/Th2). [38] When both fenugreek and honey were employed in the treatment process to lower the IL4 levels, the effectiveness of fenugreek was significantly greater than that of honey. Separation of IL4 after T lymphocytes and mast cells may result in airway swelling and Ig-E production. [39] Additional research determines the role of interleukin4 antibodies, interleukin5 antibodies, and interleukin13 antibodies in the pathophysiology of asthma; thus, production cycles among TH1 and TH2 cytokines may help with asthma treatment. [40]

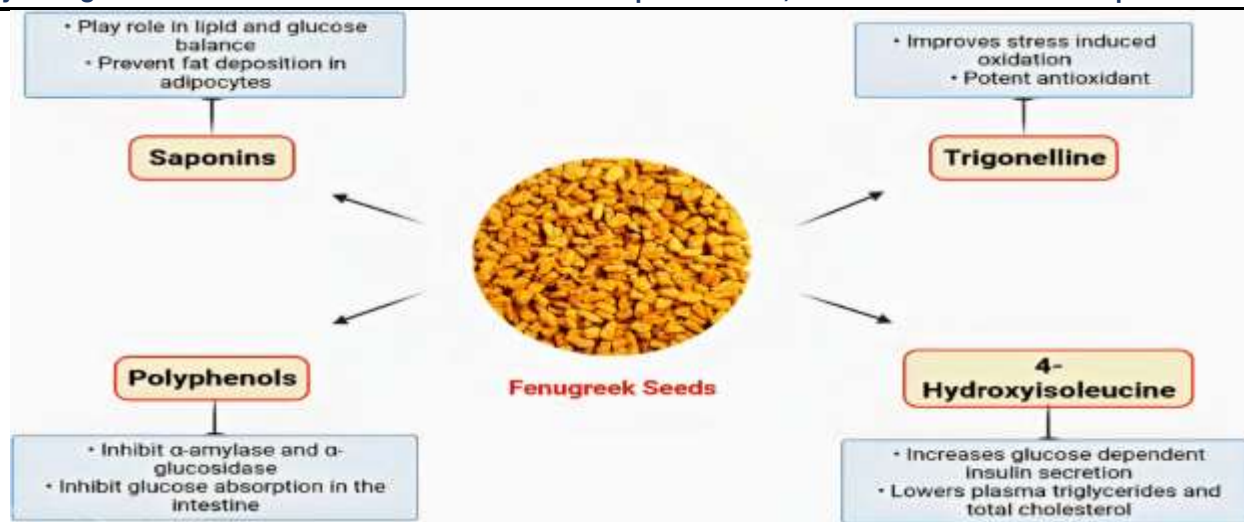


Figure 2. Fenugreek seed

Other Beneficial Effects

1. A study on ethanol-induced stomach ulcers has demonstrated the gastroprotective action of fenugreek seeds.(47)
2. Dietary fenugreek reduced pancreatic amylase and trypsin.(48).
3. In alloxan-diabetic rabbits, oral fenugreek fraction (100 mg/kg) for 15 days enhanced glucose tolerance.(49)
4. A recent study demonstrated how fenugreek leaves can lower cholesterol in people with diabetes mellitus.(50)

Adverse effects of fenugreek:

1. Because fenugreek may cause uterine contractions, as shown in animal studies, it should not be used during pregnancy.[41]
2. The issue was linked to a metabolic disease and the sotolon content of fenugreek seeds, which are used to make herbal tea.[42]
3. Women who take aspirin and warfarin should use fenugreek sparingly.
4. Long-term usage of fenugreek is not advised for women who use it to improve their milk production. It is advised to perform blood glucose testing and coagulation time checks when using.
5. Hypersensitivity reactions have been documented, such as face angioedema following topical fenugreek paste application for dandruff and rhinorrhea, wheezing, and fainting following inhalation of the fenugreek seed powder [43]. [44]
6. Studies employing high dosages of the seeds have reported mild stomach distention and dyspepsia [45].

Dosage and usage technique.

At mealtimes, use 5 to 10 g of powder three times a day. (46)

CONCLUSIONS

Recent decades have seen the experimental demonstration of several health benefits of the spice fenugreek, which may one day be used therapeutically. The value of *Trigonella foenum-graecum*'s many pharmacological properties is highlighted in this review (Table 1). This plant has been the subject of numerous investigations; nevertheless, this study only touched on a few of the novel medicinal actions. Therefore, this plant's anti-toxic potential and anticataract impact are important pharmacological activities that warrant more research in the future.

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