

## A review of ethnobotanical and pharmacological approaches of Fenugreek (*Trigonella foenum-graecum*)

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**ABSTRACT:** The accelerated progression of assorted human diseases could be a direct result of fashionable lifestyles, consumption habits, stress, environmental variables, and in-depth use of artificial chemicals in food process and agriculture to treat or stop the start of those lifestyle-related diseases, researchers are looking the globe over for natural healthful agents because of the presence of assorted bioactive chemicals, a good type of healthful plants have incontestable the potential to be usually used in therapies. Fenugreek could be a vital herb that has gained worldwide recognition from various scientists as an important therapeutic plant. Various studies have shown that this plant is effective in treating a good variety of conditions, together with cancer, symptom, diabetes, and inflammation. (*Trigonella foenum-graecum*) the plant is additionally referred to as methi and is employed in Ayurvedic medicines for the treatment of respiratory disease, rheumatism, abscesses or wounds, and biological process abnormalities. In fashionable food technology Fenugreek is employed as a food stabilizer, adhesive and emulsifying issue owing to its gum, protein, and fibre content. It's an upscale supply of metal, iron, and different vitamins. Gum, fibre, alkaloids, flavonoid, saponins, and volatile compounds square measure plentiful in fenugreek seeds. Fenugreek may be used as an anti-anorexia, anti-diabetic, anti-carcinogen anti-oxidant, antimicrobial, and treatment for hypercholesterolemia and symptom. In this review we discussed fenugreek's chemical composition, taxonomical background and along with some pharmacological aspects of the herb as a neuroprotective & anti-diabetic agent.

**Keywords:** *Trigonella foenum-graecum*; Neuroprotective; Nutraceutical approaches; Isoleucine; 4-hydroxy isoleucine.

### I. INTRODUCTION:

[1] The food industry has been pushed to create food products that enhance wellness due to the rising customer demand for healthier eating. Foods that offer substantial nutrition, exert health benefits, prevent disease, and/or promote health have gained industry acceptance and can be used as effective marketing tactics. Functional foods, which contain various ingredients like probiotics, prebiotics, vitamins, minerals, and dietary fibre have become more popular due to this. In this regard, various herbs have been taken into account for their use in food production, antibacterial, antioxidant, and health promotion applications.

[2-3] India is the world's greatest producer of fenugreek, but because of its substantial domestic consumption, it does not account for a significant portion of the commerce in fenugreek.

[4] The region's dry and semiarid climates include those of Asia, Africa, and the Americas. The herb has been utilized for many centuries in Tibetan and Chinese traditional medicine and Indian Ayurvedic treatment. Additionally, current research has shown that fenugreek germ and leaf are effective in treating a variety of ailments, including successfully lowering blood sugar and lipid levels in both rodents and humans during experimental trials [5].

The crop may serve as a cure-all for diseases including cancer, diabetes, and microbes. Diosgenin, trigonelline, galactomannan, and 4-hydroxy isoleucine are only a few of the several significant phytochemicals that give fenugreek its wealth of therapeutic benefits [4]. The crop is therefore in high demand globally in the related pharmaceutical, nutraceutical, and functional food sectors. Fenugreek is widely used in industrial sectors because it is a crop that is known for its chemical properties. Its seeds are a trustworthy

source of diosgenin, a steroid used as a remedy in the pharmaceutical business[6].

Fenugreek seeds contain a variety of bioactive compounds, such as amino acids, flavonoids, and saponins (such as quercetin, rutin, and vitexin), as well as graecunin's, fenugreek B, and other saponins (isoleucine, 4-hydroxy isoleucine, histidine, leucine, lysine). It works as a medicine for several conditions, such as allergies, catarrh-related appetite loss, bronchitis, cholesterol levels, diabetic retinopathy, gas, ulcerative colitis, lung damage, excessive mucus, dry cough, abscesses, anaemia, breathing issues, percolates, aroma, bronchitis, cancer, oedema eyes, pneumonitis, gallbladder problems, heartburn, inflammation, sinus problems, ulcers. An Indian study found that fenugreek bean can help lower

blood sugar and several other harmful fats. Fenugreek is employed as a spice and medicine all over the world. The leaves are eaten as green leafy vegetables in the diet. Fenugreek seeds have a characteristic odour and have been eaten for more than two million years.

It is widely known for its fibre, gum, different chemical elements, and risky contents. The dietary fibre of fenugreek seed is ready by 25% which modifications the feel of meals. These days it's far used as a meal stabilizer, adhesive and emulsifying agent because of its excessive fibre, protein, and gum content. The protein of fenugreek is located to be greater soluble at alkaline pH. Fenugreek is having a useful effect on digestion and additionally has the cap potential to regulate meals[7].



### Production and Cultivation

Table 1: Fenugreek Sources with references to species

SPECIES	COUNTRY
➤ <i>T coeruleascens</i>	Iran
➤ <i>T striata</i>	Iran
➤ <i>T moreshshina</i>	Iran, India, Africa, Egypt
➤ <i>T foenum-graecum</i>	Iran, Turkey
➤ <i>T coeruleascens</i>	Iran
➤ <i>T aphanoneora</i>	Iran
➤ <i>T tehranica</i>	Iran
➤ <i>T elliptica</i>	Iran
➤ <i>T monantha</i>	Iran
➤ <i>T astroites</i>	Iran
➤ <i>T uncata</i>	Iran
➤ <i>T anguina</i>	Iran, Saudi Arabia
➤ <i>T stellate</i>	Iran, Saudi Arabia
➤ <i>T fischeriana</i>	Turkey
➤ <i>T velutina</i>	Turkey
➤ <i>T cretica</i>	Turkey
➤ <i>T hamosa</i>	Saudi Arabia
➤ <i>T corniculata</i>	India

Fenugreek can be found in both wild and domesticated versions all over the world. Today, fenugreek is grown on six continents: Australia, Europe, Africa, Asia, South America, and North America. Fenugreek (*Trigonella foenum-graecum*) distribution (Table.1) **Listfoenum-graecum L. sources.** There are reportedly two *Trigonella* species that are both economically significant and cultivated. These are fenugreek, namely *T. foenum-graecum* (common seed type) and *T. corniculata*

(leaf type). In countries including India, Morocco, China, Pakistan, Spain, Tunisia, Turkey, Lebanon, Israel, Egypt, Ethiopia, Kenya, and Tanzania, fenugreek is grown as an economically significant crop. In addition to these nations, it is grown in Portugal, the United Kingdom, Germany, Austria, Switzerland, Sudan, Greece, Japan, Russia, Argentina, Australia, Canada, and the United States.

**Table: 2. Major Geographical Rich regions for the production of Fenugreek**

S.NO	COUNTRIES	CONTINENTS
1.	India, China, Iran, Israel, Japan, Russia, Lebanon, Nepal, and Pakistan	Asia
2.	Egypt, Ethiopia, Kenya, Morocco, Sudan, Tanzania, and Tunisia	Africa
3.	Austria, France, Germany, Greece, Portugal, Russia, Spain, Switzerland, Turkey, and the UK	Europe
4.	Argentina	South America
5.	Canada and the USA	North America
6.	Some Portions of Australia	Australia

**TAXONOMICAL BACKGROUND**

Kingdom: Plant
Family: Fabaceae
Genus: <i>Trigonella</i>
Species: <i>foenum-graecum</i>
General name: Fenugreek
English name: Fenugreek
Arabic name: Hhulbah, Hhelbah
French name: Trigonelle, Senegrain, Foingrec
German name: Gemeiner, Homklee, Bockshomklee
Indian name: Sagmethi, Methi, Kasurimethi
Italian name: Fienogreco, Erbamedica
Persian name: Shanbelileh

**Table:3 Taxonomical background**

### Chemical Compositions

Steroid saponinogens are one of the several chemical components found in fenugreek. The hydrophobic embryo of fenugreek has been shown to have a diosgenin component. Two F-ring opening diosgenin precursors known as furastanol glycosides, also known as hederagin glycosides, have been found in fenugreek. The stem contains alkaloids like trigocoumarin, nicotinic acid,

trimethyl coumarin, and trigonelline. One particularly noticeable component of the seeds is the mucilage[11]. The stem contains 28% mucilage, a volatile oil, two alkaloids like trigonelline and choline, 5% of stronger-smelling, bitter-fixed oil, 22% proteins, and an ingredient that gives it a yellow hue [10]. Fenugreek has roughly 25% dietary fibre, 23-26% protein, 6% fat, and 58% carbs [9].

S.no	Class	Chemical Composition
1.	Alkaloids	Trimethylamine, Neuron, Trigonelline, Choline, Gentianine, Carpaine and Betain
2.	Amino acids	Isoleucine, 4-Hydroxyisoleucine, Histidine, Leucine, lysine, L-tryptophan, Argentine
3.	Saponins	Graecunins, fenugreek B, fenugreek in, trigofoenosides A-G.
4.	Steroidal	Yamogenin, diosgenin, smilagenin, sarsasapogenin, tigogenin, neotigogenin,
5.	sapinogens	gitogenin, neogitogenin, yuccagenin,saponaretin
6.	Flavonoids	Quercetin,rutin,vetixinisovetixin
7.	Lipids	Triacylglycerols, diacylglycerols, monoacylglycerols, phosphatidylcholine phosphatidylethanolamine, phosphatidylinositol, and free fatty acids.
8.	other	Coumarin, lipids, vitamins, minerals. mucilage; proteins; stronger-swelling, bitter fixed oil.

**Table: 4- Composition of Fenugreek**

Source: (Yadav et al., 2011), (Sowmya and Rajyalakshmi, 1999)

### Nutraceutical Approach of Fenugreek

Fenugreek has a positive impact on purifying the blood, and because it is a diaphoretic, it can cause sweat and aid in body detoxification. due to the overpowering fenugreek odour that may be smelled both on the dermis and in sweat from the underarms. The essential function of fenugreek is to nourish the cells with nutrients, and flush out harmful wastes, dead cells, and stuck proteins from the body. It is also well known for its lymphatic cleansing effect. Anywhere in the body of the patient, a block in the lymph nodes can result in poor fluid circulation, peripheral oedema, pain, energy loss, and disease. By aiding in the clearing of congestion, fenugreek helps to maintain mucus conditions in the body, particularly the lungs. It also serves as a mucus solvent and throat cleaner, which lessens the need to cough. Drinking water with fenugreek seeds steeped in it aids in collecting and hardening, liquefying, and dissolving the aggregates of cellular waste.

Colds, bronchial problems, influenza, asthma, catarrh, diarrhoea, rhinitis, lung inflammation, pneumonitis, hoarseness, laryngitis, hay fever, tuberculosis, and emphysema have all been treated with fenugreek. [12]

A wide variety of micronutrients and phytochemical compounds found in fenugreek are necessary for enhancing the health and efficiency of biological systems. Fenugreek seeds contain 58 percent carbs, 23 to 26 percent proteins, 0.9% lipids, and 25 percent fibre. Fenugreek leaves have 6%, 4.4%, 1.1%, and corresponding amounts of carbohydrates, proteins, and fiber[8]. Fenugreek additionally has many minerals, including K<sup>+</sup> (603 mg/100 g), magnesium and potassium (42 mg/100 g), calcareous (75 mg/100 g), zinc (2.4 mg/100 g), copper and manganese (0.9 mg/100 g), and iron (25.8 mg/100 g). Carotenoids (19 mg/100 g) and Vit C (220 mg/100 g) are also thought to be essential fenugreek ingredients.

Several essential amino acids, including asparagine, glutamic acid, leucine, tyrosine, and

phenylalanine, are abundant in fenugreek. It also contains trace amounts of methionine and cysteine, two sulphur-containing amino acids with important physiological functions in the body. (2S, 3R, 4S)-4-hydroxy isoleucine is the free amino acid that is most frequently found in fenugreek. The semi-amino acid 4-hydroxy isoleucine makes up around 80% of the amino acid content of dried fenugreek seeds, and throughout the growth phase, it multiplies rapidly. Studies have shown that fenugreek's proteins are of higher quality than those found in other plants[13].

Trigonella, trigocoumarin, nicotinic acid, and trimethyl coumarin are a few of the alkaloids found in large amounts in fenugreek. Additionally, it contains other significant, beneficial substances including flavonoids and polyphenols. Numerous different flavonoids, including quercetin, luteolin, vitexin, and 7, 4-dimethoxy flavanones, are detected in the alcoholic extracts of the fenugreek plant. Other organizations have Isoleucine 4-hydroxy (amino acid) Activity that stimulates insulin dietary fibre (soluble), galactomannans, and non-starch polysaccharides Food toxin binding, colon mucus barrier defenced insulin secretion, intestinal water retention, and glucose absorption control.[14-15]

### Pharmacological Approaches of Fenugreek

Fenugreek, or *Trigonella foenum graecum* Linn (Fabaceae), is a leafy vegetable and condiment that originated in Eastern Europe but is now grown all over the world. [16-17] Researchers' attention has been drawn to it as a result of its therapeutic success in treating several pathological disorders that have been documented in pre-clinical and clinical trials.

Alterations in lipid metabolism are typically associated with hyperlipidemia, which is thought to be a causal risk factor for several illnesses, including neurological conditions like depression, cognitive decline, and neurodegenerative diseases like Alzheimer's disease, Parkinson's disease, and Huntington's disease. All of these brain illnesses have been directly linked to oxidative stress in addition to hyperlipidaemia[18-19].

### Neuroprotective treatment approaches of Fenugreek

In the presence of a physiological threshold value, the second messengers produced by cell metabolism—ROS—destructively interfere with normal cellular activity. Numerous processes

in the brain contribute to the creation of ROS, which causes neurons to degenerate since they have a limited ability to detoxify ROS. Following that, a sustained increase in free radicals raises the intracellular calcium ion ( $Ca^{++}$ ) level. The regulation of neural plasticity, which is necessary for learning, memory, and neuronal survival, depends on calcium ions.

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Diabetes, a form of hyperglycaemia, causes an abrupt rise in the production of free radicals and an excessive release of calcium ions, which hurts synaptic function and neural attrition, the root causes of brain damage. [22]

Moreover, there is evidence that hyperglycaemia increases lipid oxidation in the synaptosomes membrane and inhibits  $Ca^{++}$ ATPase, which hurts vascular permeability, membrane enzymes, and the uptake of neurotransmitters. These effects further contribute to neurological implications.[23-24]

Fenugreek seeds have been found to have immunomodulatory effects in addition to their hypolipidemic and hypoglycemic effects. Preclinical research on Wistar rats has shown that fenugreek seed supplementation reduces aluminum-induced toxicity, inhibits its hypoproduction of IL-6 in the posterior brain, and activates astrocytes (GFAP reactivity)[25-27]

### Therapeutic Response to Body Weakness and Anorexia

Children's skeletal TB and osteomyelitis can be effectively treated with this herb. Due to the plant's iron, phosphorus, carbohydrates, diastases, and other nitrogen compounds, some disorders caused by anorexia and myasthenia can be cured. Additionally, this plant can be employed in a variety of circumstances where the prescription for iron and phosphorus supplements is required.[28]

### Effectiveness in Decreasing or Controlling Blood Glucose.

Effectiveness in managing blood glucose was noted in a double-blind clinical investigation conducted by Gupta et al 25 individuals with type II diabetes were split into two groups; one group took 1 gram of dry hydroethanolic fenugreek seed extract daily, and the other used diet and exercise to regulate blood sugar. After two months, blood

sugar levels dropped in both groups (in the fenugreek group, between 148.3 to 119.9 mg/dL, and in the diet and sports groups, between 137.5 to 113 mg/dL), but there was no discernible difference between the 2 groups.

Researchers concluded that fenugreek, along with diet and exercise, could help type 2 diabetic people control and lower their blood sugar levels. A randomized, controlled, crossover research was carried out on individuals who had diabetes type 2. In the trial, eating a diet containing fenugreek dramatically reduced blood sugar levels between 179 + 24 to 137 + 20.2 mg/dL. Both groups showed an improvement in glucose tolerance as well as reduced hyperphagia and polyuria symptoms. Other completed case studies have demonstrated that fenugreek seed regulates and enhances blood sugar levels in people with type 2 diabetes.[29]

#### Adverse Effects of Fenugreek

Fenu-gastritis hasn't been associated with any unique adverse effects. One instance of a 5-week-old new-born whose consciousness level decreased after receiving fenugreek-containing herbal tea has been documented. An existing metabolism abnormality and the existence of sotolon in the fenugreek seed used to make herbal tea were the causes of the issue. A strong aromatic derivative of lactone.

It is a substance that is used, and it smells like fenugreek or curry. It contains a large amount of the fenugreek seed's fragrance component. Additionally, it can be found in aged sake and white wine, dried fruiting affects the bodies of the mushroom, and tobacco properties.

- Women who exhibit asthma-related symptoms or digestive issues should use caution when consuming fenugreek in special circumstances.
- It is important to think about the bare minimum consumption needed to produce an effect.
- Women with high blood pressure and cardiovascular illness should refrain from using it.
- Skin sensitivity to fenugreek should be tested in women, before administration.
- Women who also take aspirin and warfarin should exercise caution when taking fenugreek.
- Long-term usage of fenugreek should be avoided by women who use it to boost their milk production. During the consuming period,

it is advised to assess the coagulation time and do a blood glucose test.

- Dosage: Use 5 to 10 g of powder, three times daily with meals.
- Drug complex interactions: There haven't been any significant medication interactions reported. [30-31]

## II. CONCLUSION

Since ancient times, fenugreek has been used extensively in the treatment and prevention of illnesses. Several of these traditional uses have been confirmed by the research that have been done, and it is now evident how valuable this plant is as a medication and how effective traditional medicine is. But there isn't enough scientific proof to determine this plant's exact method of action. There is a sizable antidiabetic effect of fenugreek. It can inhibit the production of insulin and slow down the metabolism of sucrose in the gastrointestinal (gi) tract, decreasing blood sugar in diabetes patients.[32]

Fenugreek is also used to treat a number of other conditions, including atherosclerosis, hypertension, appetite loss, gastritis, and inflammation. Fenugreek is occasionally used by nursing mothers to encourage milk production. However, the mechanisms that operate in these circumstances are unknown. Fenugreek can be utilized by people who lack iron because it contains a high level of iron. [32]

It is used to treat kidney issues as well as a few other toxicities. It exhibits antioxidant activity, and it appears that this plant's antioxidant capacity is one of the primary contributors to the effects of fenugreek. Numerous active phytochemicals, such as antioxidants, polyphenolic compounds, vitamins, curcumins, terpenoids, carotenoids, lignin, and saponin, have been linked to the plant's antioxidant properties. However, the biggest contribution to this action has come from phenolic chemicals. Consequently, the extract's antioxidant activity and the polyphenolic components found in it show a strong link.[33-35]

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