


Review Article
THERAPEUTIC SIGNIFICANCE OF FENUGREEK W.S.R TO ITS HYPOLIPIDEMIC ACTIVITY
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ABSTRACT

The term 'Hyperlipidemia' denotes excessive cholesterol in the blood. It is both LDL and triglycerides that are elevated in hyperlipidemia. As per Ayurveda, In Hyperlipidemia, *Medodhatu* vitiates because of improper working of *Parthiva* and *Aapbhatagni* rasa and *Medodhatvagni*. Mainly *Asthivahasrotas* are affected. *Asthivahasrotas* build from *Medo* and *Jaghan* part. Fenugreek having lipolytic property and it primarily works on *Annahvasrotas* and *Asthivahasrotas*. It decreases cholesterol level, reduces body weight by decreasing plasma triglycerides and having hepatoprotective effect. Fenugreek (*Trigonella foenum graecum*) commonly known as '*Methi*', family Fabaceae is a annual plant, cultivated world wide as a semiarid crop. The seeds of fenugreek are used as condiment and dried leaves as flavouring agent. Vegetative parts are rich in vit. A, vit. B and iron. Constituents of fenugreek seeds include flavonoids, alkaloids, coumarins, saponins; most prevalent alkaloid is trigonelline and coumarins include cinnamic acid and scopoletin. In southern part of India roasted seeds in the form of infusion are indicated in diarrhoea and small pox. It is an appetizer and carminative. It's porridge is used as galactagogue. Having antidiabetic, antiallergic, lactation induced, anti-oxidant potency. In this article we are going to discuss about fenugreek in all aspects including its Anti-hyperlipidemic action.

KEYWORDS: Hyperlipidemia, *Medodhatu*, Lipolytic, Trigonelline, Galactagogue.

INTRODUCTION

Fenugreek (*Trigonella foenum-graecum* L.) is one of the oldest medicinal plants, originating in India and Northern Africa^[1]. It is native to the Mediterranean, India, China, Northern Africa and the Ukraine, as well as being widely cultivated in those locales. Cultivated commercial products in the United States come mainly from Morocco, Turkey, India and China.^[2]

The genus name *Trigonella*, has the Latin meaning 'little triangle', owing to the triangular shape of its flowers. The species '*foenum-graecum*' means 'Greek hay'. It is also known as 'ox horn' or 'goat horn' because its two seed pods project in opposite directions from the nodes of the stem base and resemble an ox or goat horns.^[3] Taxonomists such as Linnaeus noted that 18 species of *Trigonella* are currently in a total of 260 species. Most species, including *Trigonella foenum graecum* L., are diploids with 2n = 16 chromosomes. However, some species of *Trigonella* may include 18, 28,30, 32 or 44 chromosomes.^[4]

An annual plant, fenugreek grows to an average height of two feet. The leaves and seeds, which mature in long pods, are used to prepare extracts or powders for medicinal use. Applications of fenugreek were documented in ancient Egypt, where it was used in incense and to embalm mummies. In modern Egypt, fenugreek is still used as a supplement in wheat and maize flour for bread-making. In ancient Rome, fenugreek was purportedly used to aid labor and delivery. In traditional Chinese medicine, fenugreek seeds are used as a tonic, as well as a treatment for weakness and edema of the legs. In India, fenugreek is

commonly consumed as a condiment and used medicinally as a lactation stimulant.

There are numerous other folkloric uses of fenugreek, including the treatment of indigestion and baldness.^[1] Roasted *Methi* grain as a coffee-substitute, particularly in Africa. It has also been used for controlling insects in grain storages and perfume industries.^[3] Trigonelline compound can be used for manufacture of maple syrup and as an artificial flavour for vanilla, rum and butter scotch.^[5] The possible antihyperlipidemic properties of oral fenugreek seed powder have been suggested by the results of preliminary animal and human trials. Fenugreek seeds lower serum triglycerides, total cholesterol (TC), and low-density lipoprotein cholesterol (LDL-C). These effects may be due to saponins, which increase biliarycholesterol excretion, in turn leading to lowered serum cholesterol levels.^[1]

Abnormalities in lipid metabolism are associated with dyslipidemia, obesity, diabetes mellitus, cardiac diseases, inflammation, and their associated disorders. Current treatment of dyslipidemia, obesity, and related metabolic disorders include various modern anti-hyperlipidemic drugs which cause untoward side effects and inflict economic burden. Fenugreek seeds (FGS) are good sources of soluble dietary fiber (SDF) and their consumption have earlier been shown to bring about a significant reduction in serum and liver cholesterol levels.^[6]

As per Ayurveda, *Brhat Trai* has not mentioned Fenugreek (*Methi*). Only *Nighantu's* have described this valuable plant. *Bhavprakash Nighantu* has mentioned its

popular formulation in *Vatavyadhi*, as *Caturbija churna* which is very effective for pain relieving conditions.^[7] *Acharya Priya Vrat Sharma* has quoted its medicinal use in *Vranasopha* as leaf of *Methika* is boiled in water after adding little ghee and applied as poultice over the abscess.^[8] The leaves are refrigerant and aperient and are given internally for vitiated conditions of '*Pitta dosha*'.^[9]

Taxonomy^[10]

Binomial name- *Trigonellafoenum-graecum* Linn.

Kingdom	Plantae
Super division	Angiosperms
Division	Eudicots
Class	Rosids
Orders	Fabales
Family	Fabaceae
Subfamily	Faboideae
Tribe	Trifolieae
Genus	Trigonella
Species	Foenum

Vernacular Names^{[11], [12]}

Sanskrit	<i>Bahuparni, Bahupatrika, Dipani</i>
Hindi	<i>Methi</i>
English	<i>Fenugreek seed</i>
Telugu	<i>Mentulu</i>
Kannada	<i>Mentiya</i>
Malayalam	<i>Ventiyam</i>
Bengal	<i>Haenugraeb</i>
Punjab	<i>Metha</i>

Synonyms-^[13]

Vallari-Slender herb.

Bahupatrika - Dense foliage leaves.

Municchada- Leaves being like those of *Agastya* tree.

Candrika- Flowers are white or yellowish.

Kunchika- fruits are curved.

Bahubija- having numerous seeds.

Pitabija- seeds yellowish in colour.

Jatigandhaphala- Aromatic seeds.

Dipani, Bodhini- It is one of the common spices which stimulates appetite and digestion.

Classical Review^[7, 14-18]

Bhavprakash has described '*Methi*' in '*Haritkyadi varg*' and included it as one of the ingredients of *Chaturbija*. *Adarsh Nighantu* mentioned it in '*Palashadi varg*'. *Raj Nighantu* quoted it in '*Pipplyadivarg*'. *Priya Nighantu* described it in '*Shatpushpadivarg*'. *Madanpal Nighantu* mentioned it in '*Shunthyadivarg*'.

Distribution^[12, 19-20]

Fenugreek is cultivated in several parts of India as commercial crop, in Punjab and Kashmir it is wildy propagated. It is native to Eastern Europe.

Morphological features^[19]

A nearly smooth erect annual. Stipules not toothed. Leaflets 2-2.5 cm. long, oblanceolate-oblong, toothed. Flowers 1-2, axillary, sessile. Calyx –teeth linear. Corolla much exserted. Pod 5-7.5 cm. long, with a long persistent beak, often falcate, 10-20 seeded, without transverse reticulations.

Active constituents^[2]

The leaves and seeds of the fenugreek plant are used as powders and extracts for medicine use. Fenugreek seeds contain 45-60% carbohydrates, most of which is amucilaginous fiber which is 30% soluble and 20% insoluble fiber. It also contains about 20-30% proteins that are high in lysine and tryptophan, a small amount of oils (5-10%), a small amount of pyridine alkaloids (mostly trigonelline), and a few flavonoids, free amino acids, saponins, vitamins and volatile oils.

Constituents in fenugreek that are thought to be responsible for its hypoglycemic effects include the testa and endosperm of the defatted seeds called the A subfraction, the 4-hydroxyisoleucine and the fiber. It is also thought that the saponins in the seeds are transformed in the gastrointestinal tract into saponins and this is responsible for the lipid lowering effects.

Fenugreek leaves, raw^[21] (% Daily Value)	
Nutritional value per 100 g (3.5 oz)	
Energy	205 kJ (49 kcal)
Carbohydrates	6 g
Fat	0.9 g
Protein	4.4 g
Minerals	
Calcium	(40%)395 mg
Iron	(15%)1.93 mg
Phosphorus	(7%)51 mg

Physical Properties^[22]

Ras-Katu

Virya- Usna

Guna-Laghu, Snigdha

Vipaka-katu

Dosha^[23]- Vataghna, Kaphaghna

Part Used^[22]- Seeds, whole plant

Dosage^[22]- Seed powder 1-3g.

Important Formulations^[22]- Pancajirakapaka, Methimodaka, Caturbija Curna.

Benefits of Fenugreek^[24]

1. 25 - 100 grams of fenugreek seeds eaten daily can diminish reactive hyperglycemia in diabetic patients.
2. Fenugreek leaves and seeds help in blood formation. They are good for preventing anemia and rundown conditions.
3. Including fenugreek seed in lactating mothers increases the flow of milk.
4. A paste of the fresh fenugreek leaves, applied on the face prevents pimples, blackheads, dryness of the face and early appearance of wrinkles.
5. For removal of dandruff in hair.
6. If you add half a teaspoon of fenugreek seeds to the lentil and rice mixture while soaking, *Dosas* will be more-crisp.

Fenugreek as potential therapeutic agent against several diseases^[25]

Apart from the usage in bakery products, frozen dairy products, condiments, spices, pickles, and beverages, fenugreek is known to have numerous beneficial health effects. Gastric ulcers can easily be treated by fenugreek seeds. The seed oil acts as an emollient and makes skin smoother and soft. The cleansing action of fenugreek

makes it a valuable plants it helps purify blood, cleaning lymphatic system, and detoxify the body. In diseases like hay fever and sinusitis it can be used. The seeds are considered useful in heart disease and aphrodisiac and as a galactogogue promoting lactation.

Different regions in the world use fenugreek for different purposes; for example, in China, seeds are used to treat cervical cancer and for kidney problems. The aerial parts of plant are used to treat abdominal cramps during diarrhea in the Middle East and the Balkans. In southern India, roasted seeds are used as a treatment for dysentery. The smallpox patients are also given an infusion of seeds as a cooling agent. Being a natural health product, it is capable of treating and curing diseases, thus providing medical and health benefits. As a result of which, it has been considered a potential nutraceutical. Apart from the traditional medicinal uses, fenugreek is found to have many pharmacological properties such as antidiabetic, antinociceptive, anticarcinogenic, antioxidant, anti-inflammatory, and hypocholesterolemic.

Antidiabetic Activity

One of the chronic metabolic diseases is diabetes mellitus which occurs as a result of disordered metabolism of carbohydrates, proteins, and lipids. Though several forms of treatments are available in terms of medications and injectable insulin, they are accompanied with side effects. Diabetes mellitus can be regulated by the food habits which not only offer an economical approach but also are rich in chemical constituents that will help in maintaining blood glucose level. One of the well-studied herbal plants is fenugreek which has been quite researched with respect to its effect on diabetes. In one of the published studies it is documented that seeds, leaves, and its extracts are a good agent in our fight against diabetes. An active compound can also be isolated from the crude extract which can perform a beneficial role against the glucose level. One such study was done in which isolation of GII from the aqueous extract of fenugreek seeds have done. This isolated compound was able to reduce blood glucose in glucose tolerance test in sub diabetic and moderately diabetic rabbits. Even in Egyptian folk medicine, fenugreek held an important place as a hypoglycemic agent. Greater amount of reduction was observed using the whole seed followed by the gum isolated from cooked or uncooked seeds. The important constituents that are found to be responsible for generating the antidiabetic effects are galactomannan rich soluble fiber fraction, saponin, and an amino acid called 4-hydroxyleucine which helped in increasing insulin in hyperglycemic rats and humans.

Antioxidant Activity

Free radicals are being studied by the researchers for a long time as radicals are a source of ROS that hamper the structure of lipid membrane and thus initiate cascade of events leading to various diseases. To suppress generation of free radicals, natural products have been found as safe and effective remedy. One of the herbal extracts which is known to have antioxidant potential is fenugreek. Various studies have been done by the researchers to determine the antioxidant potential of

fenugreek. In one of the experiments on rat liver to evaluate the antioxidant potential of fenugreek seeds and it was found that methanolic seed extract was able to quench the free radicals. The constituents that are understood to be responsible were flavonoids and phenolic compounds which generally marks their presence in the polar solvent system due to their self-polar nature. Thus, due to the ability of fenugreek extracts to quench the radicals, it can be a useful candidate to alleviate the harmful effects of various diseases and thus can be used for treatment purposes.

Antitumor and Anticarcinogenic Activity

The chemical constituents of fenugreek possessing anticancer activity are phytoestrogens and saponins. Saponins selectively inhibit cell division in tumor cells and also can activate apoptotic programs which can lead to programmed cell death. In an *in vivo* study that was carried out on rats, azoxymethane was used to induce colon cancer. The effect of fenugreek seed powder along with its bioactive compound diosgenin was checked and it was observed that both the crude extract and diosgenin were able to inhibit the formation of aberrant crypt foci (ACF) which can be observed as preneoplastic lesion. After the positive response of the extract *in vivo* experiment, anticancer potential of diosgenin was explored *in vitro* experiments. HT-29 human colon cancer cells were used and it was seen that diosgenin inhibited the proliferation of cells along with the induction of apoptosis. It is reported diosgenin to have anticancer activity in bone cancer. It suppressed cell proliferation and development of bone cells through inhibition of tumor necrosis factor. Protodioscin, a furostanol saponin isolated from fenugreek, also induces apoptotic changes leading to death in a leukemic cell line (HL-60).

Several studies on anticancer properties of chemical constituents of fenugreek have been done and have shown positive results. Some constituent of alkaloids, called "trigonelline," has revealed potential for use in cancer therapy. Intraperitoneal administration of the extract resulted in change in number and growth pattern of ascites cells and tumor growth was also seemed to be significantly inhibited. *In vitro* studies of the ethanolic seed extract revealed its cytotoxic effect on a number of cancer cell lines such as breast cancer cell lines, prostate cancer cell lines, and pancreatic cancer cell lines. It is observed that fenugreek seeds in the diet inhibited colon carcinogenesis by modulating the activities of β -glucuronidase and mucinase. The seed powder in the diet decreased the activity of β -glucuronidase significantly and prevented the free carcinogens from acting on colonocytes. Mucinase helped in hydrolyzing the protective mucin. This was attributed to the presence of fiber, flavonoids, and saponins.

Hypocholesterolemic Activity

Anticholesterol activity of fenugreek extracts has been well studied by the researchers all over the world. Studies have been performed *in vivo* and were not limited to the rats and mice as they were also performed on different species of rabbits. A study was done to test the effects of fenugreek leaves on the cholesterol level. There

was a reduction in total blood cholesterol, LDL, VLDL level, and triglycerides and there was an increase in HDL cholesterol level after the consumption of dried fenugreek leaves in Albino rabbits. Presence of cholesterol in plasma is an indicator of coronary heart disease. Researchers have studied the effect of fenugreek seed extract on the lipid profile of plasma. Fenugreek seed administration and its extracts significantly decreased plasma cholesterol, triglyceride, and LDL cholesterol. The chemical constituents responsible for the activity are saponins, specifically diosgenin, galactomannan, and fiber.

Anti-Inflammatory Activity

Fenugreek for past many years has been in use as a traditional medicine in several countries like Iran, southern India, and African countries as a remedy for inflammation and its related effects. The main chemical constituents responsible for the anti-inflammatory activity are alkaloids, saponins, and flavonoids. Not only seeds but also antipyretic and anti-inflammatory activity of the leaves of *T.foenum-graecum* have been reported.

Antimicrobial Activity

For past many years, scientists have been working on natural extracts to evaluate the antimicrobial properties for the development of novel therapeutics. Several plant systems such as *Coriandrum sativum*, *Curcuma longa*, *Citrus lemon*, and *Ocimum sanctum* have been studied by the scientists which exhibited antimicrobial action. Among various varieties of herbal extracts, fenugreek is also one of the candidates that have been tested for its activity against wide variety of microorganisms like bacteria, virus, and fungus. Secondary metabolites found in fenugreek seed extract possessed the antimicrobial activity as could be understood by various studies done by scientists. Similarly, these constituents can be found in the leaves of the fenugreek herb which can also exhibit the same property. Fungus being one of the microorganisms has also shown its sensitivity towards one of the proteins called defensin extracted from fenugreek leaves. Defensin not only inhibited the mycelial spread of *Rhizoctoniasolani* but also inhibited spore germination and consequential hyphal growth of *Phaeoisariopsis*.

Gastro protective Effect

In addition to various kinds of extracts, researchers have tried to extract oil from fenugreek seed which also possesses pharmacological properties. One such property is gastro protective activity observed in oil extracted from fenugreek seed. The incidence of gastric ulceration, mean ulcer score, and ulcer index were found to be significantly decreased in a group of mice subjected to indomethacin to induce ulcer. The decrease in the gastric ulcer can be attributed to phytic acid, saponins, and trigonelline found in the essential oil of fenugreek. One of the studies reveals protective effect of aqueous extract of fenugreek seed against reflux esophagitis (RE) in rats and thus its potential to be used in clinical trial studies.

Fenugreek showing Hypolipidemic effect^[26-28]

Hypolipidemic Effect of Fenugreek Seeds and its Comparison with Atorvastatin on Experimentally Induced Hyperlipidemia

The fenugreek seeds contain the phenolic compounds, mainly flavonoids. An amino acid compound, 4-hydroxyisoleucine, was identified in the fenugreek extract by using an LC-MS apparatus in the positive ionization mode. The hypolipidaemic effect of the fenugreek seeds could be attributed to the presence of 4-hydroxyisoleucine, an atypical, branched chain amino acid. The lipid lowering effect of fenugreek is due to its action on the adipocytes and the liver cells, which leads to decreased triglycerides and cholesterol synthesis in addition to an enhanced low density lipoprotein (LDL) receptor mediated LDL uptake.

Anti-Hyperlipidemic Activity of Fenugreek (*Trigonella Foenumgraecum*) Seeds Extract In Triton And High Fat Diet Induced Hyperlipidemic Model: (A Potent Anti-Atherosclerotic Agent)

The hypolipidemic effect of fenugreek is might be largely due to its high content of soluble fiber, which acts to decrease the rate of gastric emptying thereby delaying the absorption of lipid from the small intestine. The finding of the study reveal that the seed extract of fenugreek can effectively control the blood levels in dyslipidemic conditions by interfering with biosynthesis of cholesterol and utilization of lipids.

The effect of an ethanol extract derived from fenugreek (*Trigonella foenum-graecum*) on bile acid absorption and cholesterol levels in rats

Fenugreek has been found to contain relatively large quantities of saponins. Saponins are a heterogeneous group of amphiphilic compounds found mainly in plants. They are highly surface-active and have many diverse properties. Most saponins are haemolytic, can bind cholesterol, and form stable foams. A crude saponin fraction isolated from fenugreek reduced serum cholesterol in rats.

CONCLUSION

Above article shows that fenugreek having several therapeutic properties and it cures many diseases. The consumption of fenugreek has proved safe for humans and it is used as a good dietary component as a good fibre source. As having many bio active components, fenugreek seeds have property to modulate glucose, LDL Cholesterol and triglycerides. Fenugreek seeds which were soaked in hot water for 8 weeks will significantly decrease the value of total Cholesterol, triglycerides and very low density lipoprotein. Finally it can be concluded that fenugreek seeds exhibit significant hypolipidemic effect and may be useful in hyperlipidemic states. This review will be helpful to carry out more scientific investigations to prove the medicinal properties of fenugreek. Proper research studies along with planned clinical trials are the need of the present so that the natural product from the plant can produce fruitful results for society.

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