

FENUGREEK - AN ELIXIR FROM NATURE

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INTRODUCTION

Fenugreek (*Trigonella foenum-graecum*) is an elixir from nature with numerous health benefits and applications. Its therapeutic properties were explicitly stated in traditional ayurvedic scripts as well as in Latin and Greek pharmacopeia. Apart from the medicinal value, it is rich in its nutritional profile including fibers, glycolipids, phospholipids, linolenic acid, linoleic acid, oleic acid, nicotinic acid, choline, niacin, vitamins A, B1, B2, C, proteins, and minerals. The green leaves of fenugreek contain fiber, calcium, β -carotene, iron, ascorbate, and zinc content more than in regular foods. The raw seed of *Trigonella foenum-graecum* is considered the most valuable part of the plant. Hypoglycemia, hypocholesterolemia, antidiabetic, antioxidant, anticarcinogenic, antibacterial agent, anti-anorexia agent, gastric stimulant, etc. are some of the therapeutic applications reported so far.



Fig1: Fenugreek

GEOGRAPHICAL DISTRIBUTION AND HABITAT

Fenugreek is a fast-growing plant that may widely grow in dry grasslands, planes, hillsides, and cultivated or uncultivated areas. It is a drought-tolerant plant that thrives in tropical regions with warm winters and moderate summers; but, the development of its leaves and flowers is temperature-dependent. It is commercially cultivated in India, Nepal, Pakistan, Spain, Afghanistan, Iran, France, Morocco, Argentina, North Africa, Egypt, the Middle East, and Turkey (Wani & Kumar, 2018).

BOTANICAL DESCRIPTION

Fenugreek is an annual herb that grows to approximately two feet (60 cm) tall with fragile stalks, yellow-white pea-like blooms with three parts, and yellowish seeds. The hard, brown, red, and yellow seeds are the components of the plant that are utilized in medicine and cooking. It shows a habitat similar to Lucerne. The seeds are brownish, about 1/8 inch long, oblong, rhomboidal, and divided into two uneven lobes by a deep furrow. The raw seeds are sticky, fibrous, and gummy and are found to be the most valuable part of the plant with a maple flavor and bitter taste.

Scientific classification	
Kingdom	<i>Plantae</i>
Division	<i>Magnoliophyta</i>
Class	<i>Magnoliopsida</i>
Order	<i>Fabales</i>
Family	<i>Fabaceae</i>
Genus	<i>Foenum-graecum</i>
Species	<i>Trigonella</i>

Table 1: Classification of Fenugreek

FUNCTIONALITY OF NUTRITIONAL CONSTITUENTS IN FENUGREEK

Protein: Proteins like globulin, lecithin, and albumin are abundant in the fenugreek endosperm. It has a high percentage of free amino acids (20–30%), especially 4-hydroxy isoleucine and histidine, both of which may enhance insulin action along with lysine.

Fiber: Fenugreek seeds are high in fiber, primarily non-starch polysaccharides that can help to regulate glucose metabolism in humans. Furthermore, fibers like mucilage, tannins, pectin, and hemicellulose restrict bile salt absorption in the colon, which aids in the decrease of LDL cholesterol in the blood. It can bind to the toxins in food and can protect the intestinal epithelial membrane from one set of cancer indirectly.

Vitamin and Minerals: Seeds of fenugreek are a rich source of vitamins like retinol, thiamin, riboflavin, ascorbic acid, choline, niacin, nicotinic acid, cyanocobalamin, calcium pantothenate, pyridoxine. It also contains a considerable amount of calcium, Sulphur, and phosphorous

Fat: Fenugreek seeds contain about 5.5 -7.5% lipids. It involves glycolipids, phospholipids, neutral lipids, and unsaturated lipid-like linoleic, linolenic and oleic acids. Fenugreek can relieve strong pain and appetite-simulating potential due to the presence of oleamide and N-acylethanolamines.

BIOACTIVE COMPOUNDS IN FENUGREEK

Fenugreek seed contains several bioactive compounds like flavonoids including luteolin, quercetin, apigenin, orientin, Isoorientin, Isovitexin, vitexin, Naringenin, Kaempferol, Vicenin-1,

saponarin, lilyn, tricin 7-O-D glucopyranoside; free amino acids like Arginine, Cystine, Histidine, Lysine, Tyrosine, Tryptophan, 4-hydroxy isoleucine (0.09%); Saponins like diosgenin, Fenugrin, Foenugracin, gitogenin, glycoside, Yamogenin, smilagenin, sarasapogenin, hederagenin, heotigogenin, tigogenin, trigoneoside; alkaloids such as Trigonelline, caprine, choline; coumarins such as trimethyl coumarin and other compounds including Vitamin A, folic acid, ascorbic acid, nicotinic acid, biotin, riboflavin, thiamin (Wani & Kumar, 2018).

PHARMACOLOGICAL EFFECTS AND MECHANISM OF ACTION

Fenugreek has medicinal significance due to its pharmacological effect on the human body. It possesses various pharmacological activities including hypoglycemic, hypercholesterolemic, antimicrobial, anticarcinogenic, anti-inflammatory, antioxidant, antiviral, etc. Additionally, it relieves fever and reduces body fat and pain. It nurtures lactation and sex hormones, reduces swelling, increases appetite, and regulates various enzymatic activities.

HYPOGLYCEMIC EFFECT

Many studies explored and proven the hypoglycemic impact of fenugreek against type 1 and type 2 diabetes mellitus in humans and animals (Wani & Kumar, 2018). It was thought that when the mucilage fiber is hydrated, it will form a colloidal-type suspension in the stomach and intestine. These affect gastrointestinal transit and slow down glucose absorption. A study assessed that maybe the fraction of galactomannan-rich soluble fiber in fenugreek was the reason for antidiabetic activity. The defatted seed of fenugreek lowers the blood glucose level, plasma glucagon, and somatostatin levels resulting in the reduction of carbohydrate-induced hyperglycemia (Al-Asadi, n.d.).

HYPERCHOLESTOLEMIC EFFECT

Increased oxidative stress and vascular endothelial dysfunction driven by hypercholesterolemia may enhance intestinal fibrosis, renal cellular damage, and apoptosis. Many studies have proven the anti-hypercholesterolemic effect of fenugreek in its various extracts. There are studies stating that the antilipidemic effect of fenugreek was due to the formation of the saponin-cholesterol complex that leads to the inhibition of intestinal cholesterol absorption. The saponin-bile complex induces an increased reduction of bile through fecal excretion (Wani & Kumar, 2018). Another study reported that diabetic patients, who consumed fenugreek seed powder (25g orally daily for 21 days) experienced a reduction in their total cholesterol levels (Basch et al., 2003). Also, the consumption of germinated seeds of fenugreek caused a considerable decrease in total cholesterol and LDL levels in twenty hypocholesterolemic adults (Sowmya & Rajyalakshmi, 1999).

ANTICANCER EFFECT

Various studies mentioned that the phytochemicals from fenugreek extracts show anticarcinogenic activity. Accumulation of polyamines in the tissues can cause rapid growth and dysregulated polyamine biosynthesis which leads to the development of pathological conditions such as cancer. Consumption of fenugreek seeds is associated with a decreased concentration of polyamines in tumor tissue. Studies have also proven that the active compound, Diosgenin in fenugreek can inhibit cell proliferation in both estrogen receptor-negative (ER)- and estrogen receptor-positive (ER)+ breast cancer cells by down-regulating the Cyclin-Dependent Kinases; CDK1, CDK-2, and CDK-4 expression. Diosgenin can also disrupt the JNK (c-Jun N-terminal kinase), ERK (Extracellular Signal-Regulating Kinase), and PI3K (phosphatidylinositol-3 kinase)/Akt signaling pathways, as well as the activity of NF- κ B (nuclear factor kappa B). The phytochemicals of fenugreek show a strong inhibitory effect against HL-60 cells, 1,2

-dimethylhydrazine [DMH] (a colon carcinogen), and 7, 12 -dimethyl Benz[a] anthracene-induced skin papilloma genesis. Studies had also evaluated that fenugreek has a growth-inhibitory effect on pancreatic, breast, and prostate cancer cell lines. The abundant chemical contents (such as saponins, flavonoids, alkaloids, and galactomannans) contained in the seed may be responsible for the chemopreventive effect of the methanolic extract of fenugreek seeds. These ingredients may function synergistically at distinct stages of angiogenesis (Al-Asadi, n.d.).

ANTIOXIDANT ACTIVITY

Antioxidants are compounds that aid to prevent the oxidation of lipids and other molecules by inhibiting the initiation or propagation of oxidative chain reactions. Free radicals are the byproducts of biological reactions. The role of free radicals in the pathophysiology of a wide range of diseases is well documented. Fenugreek includes several vital antioxidants and can prevent free radical damage to internally produced antioxidants (Al-Asadi, n.d.). It can reduce cell death and aging (Ahmad et al., 2016). According to the studies, the aqueous component of fenugreek showed the highest antioxidant activity. Studies revealed that the extracts of germinated, roasted, and soaked fenugreek seed flours possess antioxidant activity of about 73.8%, 32.0%, and 60.7% respectively whereas the antioxidant activity of raw fenugreek seed flour was 18.1%(Pandey & Awasthi, 2015)

CARDIOPROTECTIVE EFFECTS

Fenugreek has a substantial lipid-modulating action in the blood. It also seems to be effective in lowering cholesterol, triglycerides, and LDL while increasing HDL levels which in turn lowers the risk of atherosclerosis significantly. Compound coumarin and other ingredients present in Fenugreek paves way for the inhibition of platelet aggregation, which reduces the risk of

abnormal blood clotting associated with heart attacks and strokes. A study revealed that phenolic groups present in the phytochemicals of fenugreek can protect the heart from myocardial damage by removing the excess free radicals and thereby it prevents the peroxidation of lipids. Also, fenugreek seeds and garlic together have a more positive impact on the activation of cardioprotective effects (Mukthamba & Srinivasan, 2015).

GASTROPROTECTIVE EFFECT

The cytoprotective effect of fenugreek seeds is due to their anti-secretory properties as well as their effects on mucosal glycoproteins. The antiulcer action of fenugreek can be due to its flavonoid content, which is shown to protect the mucosa by inhibiting the formation of ulcerative lesions in the stomach mucosa caused by numerous necrotic agents, hence reducing mucosal harm. It has been reported that the polysaccharide portion of fenugreek seeds forms a mucin-like galactomannan gel layer on the mucosa's surface, or forms a protecting complex between gel and mucus as a barrier against agents introduced into the stomach or endogenously formed acid and pepsin in the stomach. The anti-ulcer effect of fenugreek seeds may be aided by an increase in sulfhydryl concentration in the gastrointestinal mucosa. Sulfhydryl compounds (SHs) in the gastric mucosa function as antioxidants and are essential for the stomach's mucosal integrity (Al-Asadi, n.d.).

ANTIMICROBIAL ACTIVITY

Fenugreek possesses antimicrobial activities due to the presence of aldehyde and phenolic compounds which were reported in many studies. The antimicrobial activity of fenugreek against 26 pathogens was reported in a study. Methanolic extract of fenugreek showed significant antibacterial activity against *Pseudomonas* spp., *Escherichia coli*, *Salmonella Typhi*, and *Shigella*

dysenteriae. Fatty oil of fenugreek seed exhibited an elevated antimycotic activity against *Aspergillus fumigatus* and *A. niger* (Al-Asadi, n.d.). Fenugreek also possesses antifungal activities against *Pythium aphanidermatum*, *Botrytis cinerea*, *Alternaria* sp., *Fusarium graminearum*, *Rhizoctonia solani*, and nematicidal activity which leads to the significant death of *Meloidogyne javanica* larvae, emphasizing potential application against nematode (Wani & Kumar, 2018).

OTHER PHARMACOLOGICAL ACTIVITIES

- Some trials indicated that the Supplementation of fenugreek seed extract shows a noticeable reduction in body and adipose tissue weight. One possibility was that fenugreek reduces total body and adipose tissue weight by flushing carbs out of the body. prior to their absorption into the bloodstream, resulting in weight loss (Al-Asadi, n.d.).
- Fenugreek can also slow down the progression of auto-immune diseases by functioning as an estrogen mimic (Al-Asadi, n.d.).
- Fenugreek seeds extract can reduce pain and skin irritation. It also provides healing, smoothening, whitening, and moisturizing effects to the skin (Ahmad et al., 2016).
- Fenugreek contains hormone precursors to enhance milk formation. According to many studies, fenugreek can boost a nursing mother's milk supply within 24–72 hours of initial consumption (Wani & Kumar, 2018).
- There are many works that reported the potential of fenugreek and its constituents in treating neurological disorders (Zameer et al., 2018)

OTHER USES

- Fenugreek can be used as a food stabilizer, food adhesive, food emulsifier, and gum (Wani & Kumar, 2018).

- Fenugreek fiber helps to fortify refined flours with a balance of soluble and insoluble fiber (Wani & Kumar, 2018).
- There are many studies showing the bioremediation potential of fenugreek in removing heavy metals (Kaur, 2016).

CONCLUSION

Fenugreek is a medicinal plant that is being used by our traditional system due to its diverse pharmacological effects on the biological system. Fenugreek has numerous bioactive compounds and can induce hypoglycemic, hypercholesterolemic, Anti-cancerous, antioxidant, cardioprotective, and gastroprotective activity in the human body. Daily consumption of fenugreek as a dietary supplement was found to be healthful and safe in many trials, as stated above.

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