Review Article

Trigonella foenum graecum (FENUGREEK) : AN HERB WITH IMPRESSIVE HEALTH BENEFITS AND PHARMACOLOGICAL THERAPEUTIC EFFECTS

Abstract

Fenugreek (Trigonella foenum graecum) is a medicinal herb and a green leafy vegetable used all over the world. It is mostly grown in India, Africa, Egypt, Pakistan, and other parts of the world. Vitamins, minerals, proteins, alkaloids, flavonoids, fibers, gums, and volatile chemicals are all found in abundance in fenugreek. It's been employed as a preservative in foods including pickles, chips, and bakery goods. Fenugreek has anticancer, anti-obesity, cardiac protective, gastro protective, antifungal – antimicrobial property, cholesterol lowering agent, anti-diabetic, anti-carcinogenic, and helps in lowering blood sugar levels, improving sexual function, and galactogogue functions, among other therapeutic pharmacological effects. The purpose of this page is to examine the many investigations, papers, and publications that look into fenugreek's therapeutic pharmacological effects, health advantages, and chemical ingredients.

Keywords *Trigonella foenum-graecum*; phytochemicals; Fenugreek; fenugreek's therapeutic; Chemical Constituents.

1. Introduction

Herbs are utilized not just in cuisine but also as medicines all throughout the world. They don't have the same side effects as chemical medications, and they don't have an alternative. People employ medicinal plants to cure and improve their general health problems in 80 percent of cases. (Naeem, 2014) Fenugreek is an annual herb that is grown in various parts of the world. Fenugreek is mostly grown in India, China, Africa, portions of Europe, and Argentina. (gupta, 1998) Gum, fibers, alkaloids, flavonoids, saponin, and volatile substances are all abundant in fenugreek seeds. Fenugreek has a protein content of 20–25 percent. Dietary fibers make up 45-50 percent of the diet. 20-25 percent soluble mucilaginous fibers steroidal saponins in the range of 2–5% 6–8% fixed fatty acid, as well as certain essential oils It also contains trace amounts of alkaloids such onoline, choline, gentianine, carpaine, and others. (trivedi, 2007) In clinical trials and experimental animals, fenugreek has various potential pharmacological uses in modern medicines for anti-diabetic, anti-lipid emic, antioxidant, hypo cholesterol emic, and antifungal, anti-inflammatory, anti-bacterial, anti-carcinogenic, antiulcer, and neuron protective nature effects. (Neelkanthan, 2014) It also plays a vital part in the development of children. According to the researcher, fenugreek was traditionally recommended for enhancing milk production in breastfeeding women. (Ghedira, 2010) The goal of this composition evaluation is to highlight the important chemical constituents, health advantages, and various pharmacological effects of fenugreek on mortal health.

2. Biological and morphological classification of fenugreek:

Fenugreek is a perennial plant in the fabaceae family that blooms every year. The biological classification of fenugreek is shown in Table 1. Fenugreek roots have a large finger-like structure, trifoliate leaves, and five petals known as wing, kneel, and banner in the flower. Pollen grains are round or oval in shape and the ovary is deep green in colour. (Basch) The fenugreek blossom is 15 cm long and yellowish brown to brownish in hue, with 2-8 pods. The seeds are 5-6 mm long, firm, and brownish in colour, and each pod contains 10-20 seeds. (Altuntas) There is about 28% adhesive; an unpredictable oil; 2 alkaloids, for example, trigo-nelline and Choline, 5% of a more grounded smelling, unpleasant fixed oil, 22% proteins and a yellow shading substance are present in stem (Grieve, 1984)The seeds of fenugreek are delightfully bitter and slightly sweet. The seeds are used to flavour a variety of foods, primarily curry powders, teas, and spice blends, and are available in whole or crushed form. (Betty, 2008) Graecunins are seven saponins found in the leaves.These chemicals are diosgenin glycosides. Leaves have an average moisture content of 86.1 percent, 4.4 percent protein, 0.9 percent fat, 1.5 percent minerals, 1.1 percent fiber, and 6% carbs. (Rao, 2003)

3. Chemical Constituents of Fenugreek

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Proteins, vitamins, minerals, alkaloids, fibers, and volatile chemicals are all found in fenugreek, and they are all highly important to the human body.

3.1 Proteins

Experiments revealed that 100g of fenugreek seeds had approximately 24.4 g of protein. (Jani R, 2009) Fenugreek proteins have excellent absorption capabilities, allowing them to easily absorb oils and water while also having a high bulk density. Fenugreek endosperm includes a variety of proteins, including albumin, globulin, histidine, and lecithin. Fenugreek proteins may have insulin-stimulating characteristics. (Mathur P, 2009)

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3.2 vitamins

Vitamins A, B1, B2, C, niacin, nicotinic acid, biotin, folic acid, and ascorbic acid are all abundant in fenugreek seeds. (Leela NK, 2008) Fenugreek leaves contain 52 milligrams per 100 grams. 2.3 per 100 g -carotene 40 micrograms of thiamine per 100 grams 310 micrograms per 100 g riboflavin 800 micrograms per 100 g nicotinic acid 0 micrograms of folic acid per 100 grams There is a 9 percent to 10% drop in vitamin content due to the boiling and heating processes needed for cooking, as well as a reduction in vitamin c concentration. (Srinivasan, 2006) Amino acids containing sulphur, such as threonine, valine, and methionine, is also present in small amounts. (Mirzaei F, Efficacy of phyto medicines as supplement in feeding practices on ruminant's performance, 2012)

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3.3 minerals

Mineral content is low in fenugreek; however phosphorus, iron, sulphur, calcium, and zinc are present in high concentrations. These minerals are extremely important and necessary for the human body's daily functions and physiological processes. (Nasri NAE, 2007) leaves are plentiful in nutrient C the ascorbic content in new leaves was determined as 276 mg for each 100 g, and leaves are likewise great hotspot for calcium, β-carotene and folic corrosive. Fenugreek plant is very much supplied with fundamental inorganic components and the plant is great hotspot for significant dietary components, like Fe, Ca, P, S and Mg. The seeds contain satisfactory measures of significant follow dietary components, for example, Co, Cu, Mn, Zn and Br (Duke, 1986)

3.4 alkaloids

Fenugreek seeds include trigonelline alkaloid, which is extracted from plant sources, as well as gentanin and carpaine choline. (Surmaghi, Medicinal Plants and Herbal Therapy, 2008) The pyridine alkaloid trigonelline contains quaternary ammonium compounds with zwitter ion characteristics. Trigonelline is also referred to as phytoestrogen because of its potential to activate oestrogen receptors. In 1885, it was discovered in fenugreek for the first time. (Joshi J., 1960). Fenugreek alkaloids, flavonoids, and saponins all have pharmacological effects. They have antilipidemic properties. Because clinical research demonstrates that serum cholesterol levels are reduced, hypoglycaemic and cholagogic qualities and their use could help manage diabetes and hypercholesterolemia. Apart from its beneficial characteristics, it should be used with caution to avoid minor gastrointestinal complaints and allergic reactions. (Izzo AA, 2005)

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3.5 flavonoids

Glycoside, orientin, isoorientin, vitexin, epigenin, and quercetin are the primary flavonoids found in fenugreek. (Mirzaei F, Efficacy of phyto medicines as supplement in feeding practices on ruminant's performance, 2012) Flavonoids exist in a complicated structure as a result of carbohydrate conjugation. These are segregated from every single portion of the plant. Flavonoid concentrations are low in each region of the plant. (Sood, 1975) Flavonoids in fenugreek have anti-tumorigenic properties, causing apoptosis (cell death) in human lung tumor cell lines, stomach cancer cells, prostate cancer cells, breast cancer cells, head and neck squamous carcinoma 3 and cervical cancer cells. Diosgenin has a lot of applications in cancer treatment.(Shishodia, 2004)

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3.6 fibers and gums

Approximately 50% of the total weight of seeds is edible dietary fiber, 30% is gel forming soluble fiber, and 20% is bulk forming fiber. Fenugreek fibers are very stable and have a longer shelf life when dried, fried, baked,

or frozen. Foods made with fenugreek fibers include pizza, bread, muffins, and cakes. They played a crucial role in the production of wafers (papads), chips, and flat bread. They have antibacterial characteristics, which prevent food from spoiling and keeping it in good condition for lengthy periods of time. (Kaviarasan, 2004) Fenugreek fibers bind to poisons in meals and protect mucous membranes from cancer-causing agents. They slowed the pace of glucose absorption in the intestine and helped to maintain a healthy blood sugar level. (Mohammadi R, 2011) Food agents are thickened, stabilized, and emulsified with fenugreek gum. It's made from the endosperm of seeds. (Brummer Y, 2003). Fenugreek fibers and phenolic acids have a significant antioxidant impact. (Madhava Naidu M, 2011).

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3.7 volatile compounds

These volatile oils have a foul odour and a bitter flavour. There are 39 different types of volatile oils. N-hexanol, dihydroactiniolide, dihydrobenzofuran, and heptatonic acid are the major molecules. (Blank I L. J., 1997) In benzene, ether, and petroleum ether, oils dissolve quickly. (Surmaghi, Medicinal Plants and Herbal Therapy, 2008) Gas chromatographic techniques were used in a 1997 investigation to detect a variety of volatile chemicals. (Blank I L. J., 1997)

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4 Traditional use of fenugreek in different countries

Fenugreek has been mentioned in Ayurvedic texts, as well as Greek and Latin. It is utilized in modern vaidyas to treat digestive and respiratory issues. Fenugreek was utilized in ancient times (methi) to enhance milk flow in women for the growth of the baby. Fenugreek was utilized by Egyptian women in recent times to ease menstruation cramps. Hilba tea is used to relieve stomach pain in Egyptians. Methi is a winter vegetable that is cooked in people's homes during the winter. Pickles and spices contain fenugreek as a preservative (masala) (Passano, 1995). Fenugreek was utilized as livestock feed by the Romans and Greeks. It is a traditional Chinese medicine treatment for leg weakness and edoema. Liquid tonics are used as medicine. (Morcos SR, 1981) Fenugreeks are high in vitamin E and are used to flavour vegetables, meat, and fish. In India, methi tea with honey and lemon is used to treat fever and is also used as a home medicine for burns, eczema, and gout. (Sinha, 2015). The plants are utilized to protect against renal illness and other ailments. Seeds are used as a pessary in China to treat cervical cancer. The seeds are taken orally as an insulin alternative to help lower blood sugar and keep it stable. (AH, 2002)

5 health and pharmacological benefits of fenugreek

Fenugreek is an herb that has therapeutic properties. It has a variety of pharmacological effects that have a positive impact on human health in those who suffer from a variety of ailments. It isn't expensive, and it doesn't have many side effects. Those who eat fenugreek obtain all of the proteins and minerals that a typical human body needs to execute physiological tasks. It's worth noting that fenugreek contains diosgenin, a chemical molecule that's involved in the production of steroid hormones like progesterone.

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5.1 Antioxidant activity

Flavonoids found in fenugreek have anti-oxidant properties. They have the ability to prevent oxidative damage to cell layers. (Anuradha C.V., 2001) Fenugreek has a lot of antioxidant properties. Due to the presence of phenolic and flavonoids, it has an effect on the liver and pancreas. In red blood cells, fenugreek inhibits lipid peroxidation (RBC) (Kaviarasan S, 2004). According to research, fenugreek seeds have antihyperglycemic and hypoglycemic properties in diabetic rats, which are attributed to antioxidant chemicals found in the plant. The activity of antioxidants in fenugreek extracts was determined using b-carotene techniques. The husk and endosperm of fenugreek seeds have 72 percent, 64 percent, and 56 percent antioxidant activity, respectively. (Adegako, 283-298)

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5.2 effect on body obesity & weight

Fenugreek, which is high in dietary fibers and proteins, has been shown to enhance the release of anorexigenic, insulinotropic, and glucagon-like peptide, which helps to lower body weight and improve glucose levels. (Reimer RA, 2008) Fenugreek plays an important function in lowering body and adipose tissue mass because it flushes away carbs from the human body before they reach the bloodstream, resulting in weight loss. Fenugreek seeds have high soluble fiber content. That fiber has a gelatinous structure, which helps with digestion and food

absorption in the colon, as well as weight loss. (Geetha M S. K., 2011) Fenugreek contains 4-hydroxyisoleucine, which lowers plasma triglycerides and thereby prevents obesity caused by a high-fat diet. (Handa T, 2005)

5.3 anti-diabetic activities

Natural medicinal herbs have been shown to be excellent anti-diabetic medicines. Fenugreek, or common fenugreek, has been shown to lower blood sugar levels and improve insulin sensitivity. Galactomannan, a type of dietary fiber, helps diabetics lower their blood sugar levels. By delaying the absorption of carbohydrates in the stomach, digestive enzymes are inhibited, bowel motion is increased, and the gut is balanced. (Sharma, 1986) (Hamden, 2010) Trigonelline has anti-diabetic properties because it stimulates the insulin signaling system. Flavone c-glycosides have been shown to inhibit digestive enzymes, increase insulin signaling, and reduce the production of glycation end products in some studies. . (Aldakinah) (Xiao, 2016) According to reports, 100g of fenugreek powder reduced blood glucose levels by 25% in type 2 diabetic patients after 10 days. Fenugreek has a strong anti-dyslipidemia effect. In mice with type 2 diabetes, this prevents platelet aggregation. Fibers with viscous gel-forming properties that impede macronutrient absorption, reduce glucose response time, and affect various blood lipids. (Hammerness P, 2003) (Hannan J, 2003) Due to the presence of fibers and galactomannans, fenugreek utilized in rice and wheat food items lowers the GI by slowing gastric emptying, lowering glucose absorption, and interdicting starch digestion. The liquid extracted from fenugreek seeds prevents diabetic nephropathy in rats by lowering blood glucose levels and increasing kidney function. (Jin, 2014)

5.4 antifungal and antibacterial effects

The key source of biological active species for improved antifungal antifungal medications is fenugreek. The entire fenugreek plant has antifungal and antimicrobial properties. Many investigations and experiments have shown that fenugreek has powerful antifungal and antibacterial properties. (Haouala, 2008) The liquid components extracted from fenugreek plants were mixed with petroleum ethers, ethyl acetate, and methanol, among other chemicals. They demonstrated their method of action and shown resistance to fungal and bacterial strains such as Rhizoctoniasolani, Fusarium Graminearum, Botrytis cinerea, Phythium aphanidermatum, and Alternaria sp. The hydro alcoholic compounds extracted from fenugreek, which are high in polyphenols and flavonoids, have antifungal activity against Candida albicans resistant to fluconazole. Both positive and negative strains with MIC against test microorganisms E.coli and salmonella typhi are inhibited by ethanolic compounds extracted from fenugreek seeds. (Randhir, 2004) .Defensins are tiny cysteine-rich peptides with significant antifungal action. The methanol soluble fraction of fenugreek extract has nematocidal activity and killed Meloidogyne javanica larvae, indicating that it might be utilized against nematodes. (T. Zia, 200)

5.5 Heart and gastro protective

Fenugreek helps to prevent irregular blood clotting by reducing platelet aggregation. This entire process is linked to heart attacks and strokes. (Natural Medicines Comprehensive) In animal research, it was discovered that fenugreek reduced myocardium damage and oxidative stress during isoproterenol-induced myocardial infarction Due to the presence of flavonoids and sulfhydryl, fenugreek is used to cure ulcers (Murugesan M, 2011) . Sulfhydryl protects mucosa from ulcerative lesions caused by a variety of necrotic causes. The presence of sulfhydryl causes an increase in gastric mucosa, which aids the anti-ulcer properties of fenugreek seeds. The Sulfhydryl molecule is an antioxidant that helps to maintain the stomach's mucosal integrity. (López A, 1996) (Choi SM, 2007).

5.6 improve sexual and galactogogue functions

Several experiments have been conducted in order to address these issues. Jiayou Materia's trial revealed that fenugreek helps with kidney problems and a variety of other disorders. In mice, the liquid extract of fenugreek increases sperm mortality and cation sperms channel proteins. Sixty fit individuals between the ages of 25 and 52 participated in a six-year study. They came to the conclusion that fenugreek seeds improved male sexual functioning, improved sexual life, and regulated orchid hormones and lactogen. (Kim, 2015) After 6 years of

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research, it was shown that giving 1200 women 2-3 fenugreek tablets (580-610mg) three times a day causes them to produce more breast milk in 1 to 3 days. (Huggins, 1998) .

5.7 Anticancer

Cancer is one of the most common causes of death all around the world. Many research utilising cell lines or animals have demonstrated that fenugreek seeds have a preventive effect against cancer. (Amin) In vitro cytotoxicity of alcoholic whole plant extracts of fenugreek against various human cancer cell lines, including neuroblastoma and cancer cell lines has been demonstrated. According to the study, fenugreek extract therapy inhibited breast, pancreatic, and prostate cancer cells, however primary prostate cells were unaffected.(Verma) The chemopreventive action of fenugreek seeds methanolic extract may be attributed to the presence of chemical elements like as alkaloids and saponins in the seeds, which function synergistically at different phases of angiogenesis. (Chatterjee S, 2012) Fenugreek seeds tea also has the ability to stop cancer cells from multiplying. Treatment with 10-15 mg of fenugreek extract for 72 hours inhibited the growth of breast, pancreatic and prostate cancer cell lines. (Shabbeer S, 2009)

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6. Conclusion

- Fenugreek is a common and beneficial traditional herb that is used in almost everyone's home as a culinary remedy. Fenugreek has a number of beneficial effects and actions against diseases and disorders such as cancer, diabetes, stomach ulcers, and cardiac issues. Fenugreek is utilized to promote sexual functions, galactogogue activities, antifungal and antibacterial properties, cholesterol lowering properties, and anti-obesity properties. Chemical elements and a high nutritional content are highly advantageous to the human body in terms of performing physiological processes and building mental and physical strength. Fenugreek can be suggested as a daily element of the diet because of its numerous health advantages and pharmacological therapeutic purposes, and it may be even more beneficial in the future.

Biological classification

Kingdom	Plantae
Subkingdom	Tracheobionta (Vascular Plants)
Division	Magnoliophyta (Flowering Plants)
Class	Magnoliophyta (Flowering Plants)
Clade	Tracheophytes
Clade	Angiosperms
Clade	Eudicots
Clade	Rosids
Order	Fabales
Family	Fabaceae
Genus	Trigonella
Species	T. Foenum-Graecum

Table 1 biological classification ((USDA)., 2008)

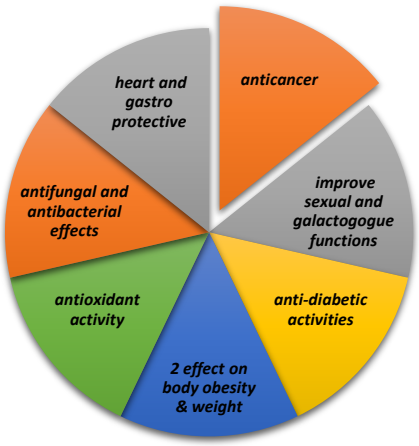

Fig 1 chemical constituents of fenugreek

LANGUAGE	COMMON NAMES
Kannada	Menthya
Tamil	Meti
Telugu	Menthulu
Malayalam	Uluva
Sinhalese	Uluhaal
Persian	Shanbalileh
Oriya	Hulba
Hindi, Urdu, Punjabi	Methi
Burmese	Penantazi
English	Fenugreek
Hindi	Methi, Saag methi, Kasuri methi
French	Fenugreec, Trigonelle
Galician	Alforfa
German	Bockshornklee, Griechisch Heu
Georgian	Solinji, Chaman
Japanese	Koruha, Fenu-guriku
Dutch	Fenugriek
Romanian	Molotru, Molotru comun, Schinduf
Assamese	Methi, Mithi
Sanskrit	Methika

Table2 common names of fenugreek

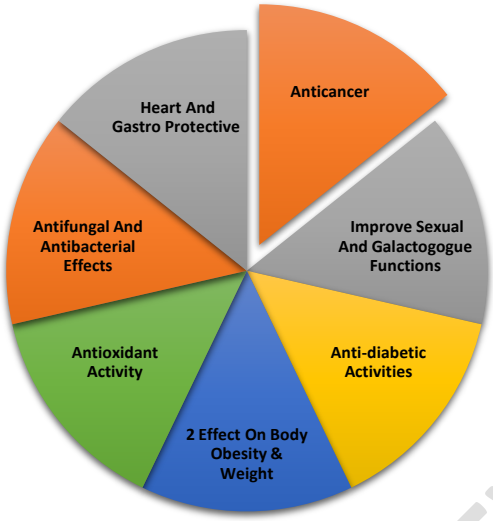

Figure 2 Pharmacological therapeutic effects of fenugreek

Chemical group	Compound	References
Alkaloids	Trigonelline, choline, carpaine	(Lee, 2005) (Kaviarasan S. N., 2007) (Rababah, 596–605)
Amino Acids	Lysine, histidine, 4-hydroxyisoleucine, tryptophan, tyrosine, cystine, arginine	(Gupta, 2001) (Ruby, 2005) (El Nasri, 2007)
Coumarins	Methyl coumarin, trigocumarin, trimethylcoumarin	(Raju, 2001)
Flavonoids	Naringenin, lilyn, kaempferol, vecenin-1, tricin 7-O-D glucopyranoside, saponaretin, isovitexin, isoorientin. Orientin, vitexin, luteolin, quercetin	(Blumenthal, 2000) (Sauvare, 2000) (Meghwal, 2012)
Saponins	Fenugrin, foenugracin, glycoside, yamogenin, trigonoesides, smilagenin, gitogenin, sarsasapogenin, yuccagenin, hederagin, diosgenin, tigonenin, neotigogenin	(Gupta, 2001)
Others	Vitamin A, folic acid, ascorbic acid, thiamin, riboflavin, biotin, nicotinic acid, gum	(Hamden K. J.-F., 2010) (Chatterjee, 2010)

Table 3 Chemical constituents of fenugreek and their classifications

NOTE:

The study highlights the efficacy of "Herbal" which is an ancient tradition, used in some parts of India. This ancient concept should be carefully evaluated in the light of modern medical science and can be utilized partially if found suitable.

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