Review Article **ISSN: 2393 – 9540**

International Journal of Nutrition and Agriculture Research

Journal home page: www.ijnar.com

https://doi.org/10.36673/IJNAR.2022.v09.i02.A04

A BIOMEDICINAL AND NUTRITIONAL PLANT FENUGREEK (METHI)

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ABSTRACT

A versatile annual legume crop with a dry land adaptation, fenugreek (*Trigonella foenum-graecum L.*) is grown all over the world. In order to consistently produce crops, seed germination and growth and development are critical components of seed structure and function. Because of its therapeutic, pharmacological, and nutraceutical qualities, fenugreek seed is utilised extensively. It's been shown to be useful in the management of hypercholesterolemia, thyroxine-induced hyperglycemia and diabetes. This review centres on the physiological processes of fenugreek seeds, encompassing significant biochemical seed elements such 4-hydroxy-isoleucine, steroidal sapogenins (diosgenin), and polysaccharide fibre (galactomannan). These ingredients have significant pharmacological and therapeutic properties that may have an effect on both human and animal health. Fenugreek has a lot of potential for introduction in sub-Saharan Africa and Latin America in appropriate agroclimatic zones. *Trigonella foenum-graecum L,* also known as fenugreek, is a multipurpose plant that is grown all over the world for its culinary, forage, medicinal, and dye properties. The first fenugreek biotechnological study was carried out in 1945, and the results discussed the effects of the triazole-type fungicide diniconazole on fenugreek cell suspension cultures. Using 10 RAPD and ISSR primers, a single paper from India presented the molecular characterisation of fenugreek, revealing interspecific polymorphism.

KEYWORDS

Fenugreek (*Trigonella foenum-graecum L.*), Methi, Medicinal properties, Pharmaceutical properties and Nutraceutical properties.

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INTRODUCTION

Trigonella Foenum-groecum L., commonly known as fenugreek, is a multipurpose plant native to the Eastern Mediterranean region that is grown extensively around the world. It is mostly grown in Pakistan, Argentina, France, India, and

Mediterranean nations in Africa and Europe, as well as in the United States. The plant can be used as a forage plant, food, condiment, dye, and medicine, among other things. For these uses, both the seeds and the leaves are employed[1,2]. The plant fenugreek has both leaves and seeds, which are used for a variety of applications. The leaves are often eaten as a vegetable and are recognised to contain a number of important nutrients, such as lipids (6.5%), gum (4.3%), ash (10.8%), protein (25.0%), starch (25.9%), and neutral detergent fibre (12.9%). Fenugreek leaves are also a great source of iron, calcium, β-carotene, and other vitamins. Fenugreek seeds, on the other hand, provide 20-30% protein, 44-59% carbs and 6-10% fat. They are used in many different contexts, such as traditional medicine, culinary ingredients, and spices. The seeds are prized for their distinct flavour and scent and may offer a number of health advantages, such as bettering blood sugar regulation, lowering inflammation, and stimulating nursing women's supply of milk[3]. Numerous potential health benefits of fenugreek have been discovered, such as its capacity to lower cholesterol, blood glucose levels, and help cure gastrointestinal issues. Fenugreek can help with insulin secretion, which can lower levels of LDL and total cholesterol, according to studies on Type 1 and Type 2 diabetics. Fenugreek has also been demonstrated to lower insulin resistance and assist maintain blood glucose levels, both of which are advantageous for those who have diabetes. All things considered, fenugreek is a healthy natural supplement that shows promise for helping people control their cholesterol and blood sugar levels[4,5].

Family: Leguminosae

Nomenclature: English: Fenugreek, Chilbe Greek: Trigonella, Hayseed Hindi: Methi Marathi: Methi Kannada: Menthya Telugu: Menthulu Bengali: Methi Oriya: Methi Punjabi: Methi Gujarati: Methi

The seed: structure and compounds

According to Fazli and Hardman[6], fenugreek seeds measure 0.3-0.6cm in length, 0.2-0.4cm in width, and 0.2cm in thickness. The radicle and cotyledon of the seeds are separated by a distinct concavity on their exterior surface, giving the seeds their irregular, rectangular, or square shape.

According to Basu (2006) and Lee (2009), the colour of mature fenugreek seeds can range from yellowish-brown to luteous, however genotypes lacking polyphenolic tannins may seem yellowish to white in colour. Furthermore, according to McCormick *et al*, (2009), certain cultivars might yield mature seeds that are green or yellowish-green in hue.

Parts Used

Seeds of *Trigonella foenum-graecum* were selected for the study (Figure).

Description

Kingdom: Plantae

Division: Magnoliophyte

Class: Magnoliopsida

Order: Fabales

Family: Fabaceae

Genus: Trigonella Botanical

Name: *Trigonella foenum-graecum*

Name of plant

Aromatic annual plant (*Fenugreek/Trigonella foenum-graecum*)

Height: 30-60cm tall

Distribution

Found wild in Kashmir, Punjab, and the upper Gangetic plains and widely cultivated in manyparts of India.

Leaves: Pinnate, 3 foliolate; leaflets 2.0-2.5cm long, oblong-oblanceolate, obscurely dentate

Flowers: White or yellowish-white, 1 or 2, axillary

Pods: 3-15cm long, containing 10-20 seeds

Seeds: Greenish-brown, 2.5-5.0 x 2.0-3.5mm oblong with a deep groove across one corner, giving the seeds a hooked appearance[7].

Chemical constituents

Nutrients and bioactive substances abound in *Trigonella foenum-graecum* seeds. With 30% soluble fibre and 20% insoluble fibre, the seeds have a high fibre content. While the insoluble fibre facilitates regular bowel movements and aids in digestion, the soluble fibre lowers cholesterol and controls blood sugar levels[8].

A range of proteins, saponins, lipids, and carbohydrates, including the mucilaginous fibre galactomannan, are also present in the seeds. Saponins, which include yuccagenin, similagenin, savsalpogenin and diosgenin, have antioxidant and

anti-inflammatory qualities and may aid in lowering cholesterol.

Trigonelline, choline, gentianine and carpaine are among the alkaloids found in *Trigonella foenum-graecum* seeds. Choline is necessary for healthy liver and brain function, whereas triphenylline has been demonstrated to have antibacterial and antidiabetic effects.

The seeds also contain flavonoid glycosides, which may help prevent chronic diseases and have antioxidant qualities. Examples of these glycosides are vicenin 1 and vitexin. It has been demonstrated that furostanol glycosides, including trigoneoside Ib, have anti-inflammatory qualities.

Free amino acids necessary for muscle growth and repair, such as 4hydroxyisoleucine, arginine, lysine, and histidine, are also present in *Trigonella foenum-graecum* seeds. The seeds are also high in calcium, beta-carotene, and the vitamins A, B2, B6, B12, and D[9,10].

Flavonoids, tannins, quercetin, mucilage, fixed oil, volatile oils, and trifoenoside A are among the other substances included in *Trigonella foenum-graecum* seeds. These substances may possess antibacterial, anti-inflammatory and antioxidant qualities, among other health advantages.

Furostanol glycoside of fenugreek seeds (trigoneoside Ib)

Furostanol glycosides are the main soluble saponins discovered in defatted fenugreek seeds, which are a rich source of saponin-rich fractions[11]. Among the several furostanol glycosides found in fenugreek seeds, trigoneoside Ib is recognised for having androgenic, anabolic, anti-inflammatory, and anti-melanogenic qualities[12,13]. Additionally, furostanol glycosides derived from various sources have shown promise in the treatment of male erectile dysfunction, cytotoxic potential, and suppression of nitric oxide generation.

Trigonesoide Ib's structure, which is 26-O-β-D-glucopyranosyl-(25R)-5αfurostane-2α, 3β, 22zeta, 26-tetraol 3-O-[β-D-xylopyranosyl (1-->6)]-β-Dglucopyranoside. Every Trigoneoside found in fenugreek has been identified by numerous researchers, who have also published [α]D, 1H NMR, and 13C NMR data for these compounds. With a molecular weight of 906, trigoneoside Ia, Ib and XIb are structural isomers with similar NMR data and distinct [α]D data. Acid hydrolysis can be used to identify a particular isomer. Trigoneoside Ia produces neogitogenin, Trigoneoside Ib produces gitogenin, and Trigoneoside XIb produces L-rhamnose. The molecular formula for tripeoneoside Ib is C44H74O19[14].

Flavonoid glycosides of fenugreek seeds (Vicenin-1 and Vitexin)

Fenugreek seeds also contain some steroidal saponins and flavonol glycosides in addition to furostanol glycosides. Fenugreek seeds contain a variety of flavonoid glycosides, including vicenin-1, isovitexin, orientin, isoorientin, and vitexin. A water-soluble flavonoid called vicenin-1 is found in fenugreek seeds. Flavonoid glycosides have antioxidant and platelet aggregation inhibitory qualities. Vicenin-1 has been shown to possess strong antioxidant, anti-inflammatory, radioprotective, and metal-chelating properties from several sources[15]. Vicenin-1 (5, 7-dihydroxy-2-(4-hydroxyphenyl)-8-[(2S, 4R, 5S)] structural formula 2, 3-(hydroxymethyl) oxan-6-(trihydroxy)] Figure 2.3 displays -6-[(2S, 4S, 5R)-3, 4, 5-trihydroxy-oxan-2-yl] chromen-4-one. Over the last ten years, research has revealed a way to synthesise vicenin-1 and produced 13C NMR comparison data between naturally occurring and synthesised Vicenin-1 (Sato and Koide, 2010). Vicenin-1's chemical formula is C26H28O14 and its molecular weight is 564.

Another flavonoid glycoside found in fenugreek seeds is called vitexin. Phyllostachys nigra (Lodd. ex Lindl.) Munro (bamboo leaves), Vitex agnuscastus L. (chasteberry or chaste tree), and Crataegus spp. (hawthorn) are among the other medicinal and plant species that contain it. These plants also boast anti-inflammatory, anti-cancer, and cardio-protective properties.

The structural composition of vitexin is 5, 7-dihydroxy-2-(4-hydroxyphenyl)-8[(2S, 3R, 4R, 5S, 6R)-3, 4, 5-trihydroxy-6-(hydroxymethyl) oxan-2-yl] chromen-4-one. Vitexin is one of the flavonoid glycosides that the researcher has extracted from fenugreek seeds. Vitexin's chemical formula is C21H20O10 and its molecular weight is 432.38[16].

PHARMACOLOGICAL PROPERTIES OF FENUGREEK

Anti-diabetic activity

The main drawbacks of synthetic medications are their hazardous side effects, high cost, and the inability of current modern therapies to control all diseased characteristics. Additionally, many rural populations in underdeveloped nations lack access to advanced therapies. Nowadays, fenugreek is one of the plant compounds that is utilised extensively in the treatment of various illnesses. Fenugreek's ability to prevent diabetes was briefly covered. Soluble fibre, or galactomannan, which is extracted from fenugreek seeds produced in Canada, has been shown to decrease the postprandial blood glucose response. The effect of galactomannan on intestinal glucose absorption in genetically determined lean and obese rats was investigated in vitro. It was designed to measure the viscosity of various combinations of galactomannan solutions. Because of its viscous quality, galactomannan may lessen the amount of glucose that is absorbed via the digestive tract, which could help with blood glucose regulation[17]. A portion of *Trigonella foenum-graecum* known as Soluble Dietary Fibre [SDF] was assessed for its potential to prevent diabetes. Oral glucose tolerance was markedly enhanced in normal, type 1 or type 2 diabetic rats by administering SDF fraction (0.5g/kg body weight). *Trigonella foenum-graecum* soluble dietary fibre was found to have effects on intestinal glucose absorption, intestinal sucrose absorption, intestinal disaccharidase activity, gastrointestinal motility, insulin production, glucose uptake and insulin action. They showed that the SDF fraction of *Trigonella foenum-graecum*, which delays the digestion and absorption of carbohydrates and enhances or mimics the action of insulin, dramatically improves glucose homeostasis in both type I and type II diabetes. SDF fraction inhibited the rise in blood glucose in rats with type 2 diabetes and non-diabetes after they were given oral sucrose. *Trigonella foenum-graecum* improved insulin action and glucose transport in 3T3-L1 adipocytes. They showed that the SDF fraction of *Trigonella foenum-graecum* seeds exerts anti-diabetic effects through enhancing peripheral insulin action and inhibiting absorption and carbohydrate digesting[18].

Lipid profile

In Western countries, atherosclerosis and associated complications account for the majority of prevalent causes of mortality. Low-density lipoprotein (LDL) oxidative alteration is a significant, if not necessary, step in the development of atherosclerosis[19].

Fenugreek was evaluated for its impact on platelet aggregation, blood lipids, blood sugar, fibrinogen and fibrinolytic activities. People who are in good health, those who have Coronary Artery Disease (CAD) and those who have Non-insulin Dependent Diabetes Mellitus, each of which can have CAD or not. When administered to healthy persons at a dose of 2.5g twice day for three months, fenugreek did not alter blood lipids or blood sugar levels during fasting or after meals. In Western countries, atherosclerosis and associated complications account for the majority of prevalent causes of mortality. Low-density lipoprotein (LDL) oxidative alteration is a significant, if not necessary, step in the development of atherosclerosis[19].

Fenugreek considerably decreased blood lipids without changing HDL-C when given in the same daily dose to NiDDM patients (mild instances), but it also dramatically decreased blood sugar when given in the same daily dose to CAD patients who also had NiDDM. Blood sugar levels in severe NiDDM cases were only marginally lowered; fenugreek had no effect on fibrinogen, fibrinolytic activity, or platelet aggregation[20].

Immunomodulatory and anti-toxic activity

In male Swiss albino mice, the immunomodulatory potential of fenugreek aqueous extract was evaluated. For ten days, mice were given three doses of the extract (50, 100 and 250mg/kg body weight). The animals' responses at the higher dose, or 250mg/kg, were either slightly stimulated in comparison to the control group animals or exactly the same. The number of cells in the thymus increased along with the weight rise. This could be partially explained by the plant extract's stimulatory effects on lymphocytes and bone marrow hematopoietic cells, which eventually find their home in the thymus. On macrophages, *Trigonella*

foenum graecum exhibited stimulatory actions. Immunostimulatory effects result from macrophages phagocytosing bacteria related to *Trigonella foenum graecum*[21,22].

Anti-cataract Activity

Worldwide, cataracts, or opacifications in the eye lens, account for 50% of cases of blindness. Cataract is still the most common cause of visual impairment and accounts for half of all blindness globally[23]. The aetiology of senile cataract has been linked to a number of risk factors. Despite ageing, cataract growth can be attributed to diabetes, smoking, gender, steroids and nitric oxide[24].

Anti-oxidant activity

By using a soxhelt extraction method and a variety of solvents, including ethanol, methanol, acetone, ethyl acetate, dichloromethane and hexane, crude extracts of fenugreek were produced. The total phenolic content, chelating activity, flavonoid content, antioxidant/radical scavenging activity, reducing powder and free radical scavenging activity of the extracts were measured using the Folin-Ciocalteu technique.

The findings demonstrate the antioxidant activity of all fenugreek extracts. Rich in proteins, mucilaginous fibre, and other uncommon chemical components that contribute significantly to sugar and cholesterol levels are found in the seeds[24-26]. The anti-oxidant activity of fenugreek seed ethanolic extract was found to be the greatest [% DPPH scavenging activity]. The polyphenolic components found in the extract may be linked to the anti-oxidant activity[27].

Figure No.1: *Trigonella foenum-graecum* tree

Figure No.2: Trigonella foenum-graecum

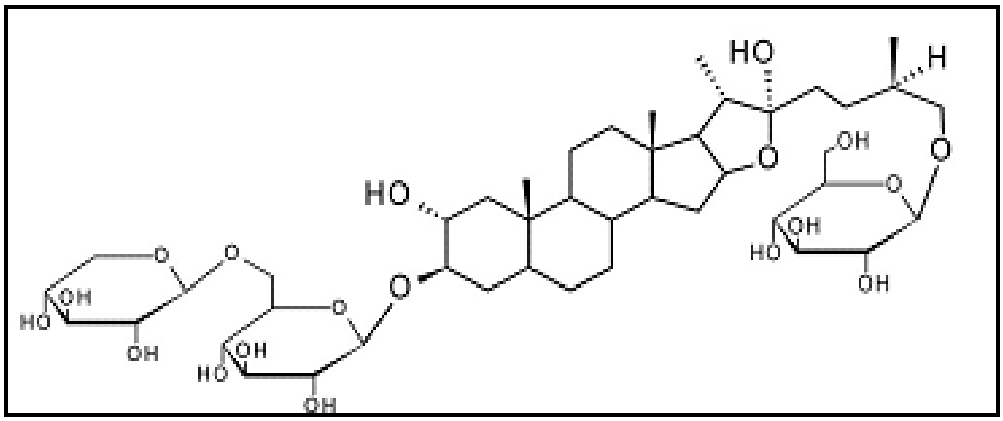

Figure No.3: Structure of Trigoneoside Ib

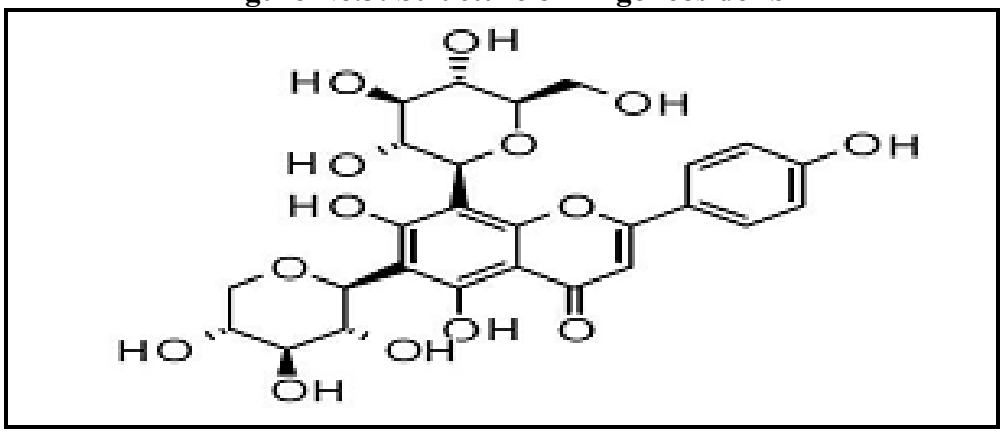

Figure No.4: Structure of Vicenin-1

CONCLUSION

The value of *Trigonella foenum-graecum's* many pharmacological properties is highlighted in the current review. Numerous investigations have been conducted on this plant; nevertheless, this study just briefly examined its novel medicinal capabilities. Therefore, this plant's anti-toxic potential and anticatarac action represent a substantial pharmacological activity that warrants more investigation in the future. Fenugreek is unquestionably safe for human health and has been used historically and supposedly as a medicinal plant since prehistoric times. Medical science has no doubts about its nutritional worth and profile of physiologically active compounds. Furthermore, this crop has the potential to play a proper role in agricultural systems due to its tolerance for drought, salt, and heavy metals, as well as its broad adaptation to a variety of climatic areas and marginal soils. Unfortunately, not much progress has been accomplished in terms of crop development thus far. As a result, there is still a significant gap, especially in varietal development and more precisely, in breeding that is aided by biotechnology.

ACKNOWLEDGEMENT

The authors wish to express their sincere gratitude to Department of Pharmacology, Joginpally B.R Pharmacy College, Moinabad, Ranga Reddy, Telangana, India for proving me necessary facilities and guideline to carry out this review work.

CONFLICT OF INTEREST

We declare that we have no conflict of Interest.

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