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Fenugreek: A Miraculous Medicinal Herb



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Abstract

Trigonella foenum-graecum L. commonly known as Fenugreek belongs to family Fabaceae. Fenugreek is both a spice and a medicinal plant, used from times immemorial by human beings as a vegetable and against various ailments and diseases. Fenugreek seeds are known to contain about 45.4% dietary fiber, alkaloids (Diosgenin and Trigonelline), saponins, aminoacids, vitamins and minerals. The plant seeds and extracts are specifically used against hyperglycaemia, hypercholesterolemia and as galactogogue. The saponins produced from fenugreek are used industrially to prepare different types of steroidal drugs.

Trigonella foenum-graecum L. commonly known as Fenugreek is native to Southern Europe, the Mediterranean region and Western Asia and is an annual herb of family Fabaceae. Fenugreek is locally known as Methi and is cultivated throughout India for a vegetable, culinary and medicinal purposes. It is also grown as fodder. This plant is well known for its miraculous medicinal properties. The plant extract is anti-allergic [1], antipyretic [2], anti-diabetic [3,4], anti-cholesterolemic [5], anti-malarial, antioxidant [6], and anti-cancerous [7,8]; it cures anaemia and respiratory disorders [9], relieves skin irritation and is used in the treatment of indigestion and flatulence [10]. It is an immunomodulatory agent and is also used as galactogogue [11]. Medicinal properties of fenugreek can be attributed to its bioactive constituents like 4-hydroxyisoleucine (4-HI), trigonelline, galactomannans, diosgenin, flavonoids, carotenoids, coumarins, proteins, saponins and lipids. Fenugreek seeds act as dietary supplement and significantly reduce the symptoms of diabetes mellitus (DM) such as polydipsia, polyuria, urine sugar, renal hypertrophy and glomerular filtration rate [12]. Fenugreek seed-alkaloid, known as trigonelline (Figure 1) controls diabetes mellitus through operation of the mechanism of insulin secretion, modulation of β -cell regeneration and stimulation of activity of glucose metabolism related enzymes [13,14].

Keywords: Fenugreek; *Trigonella foenum-graecum*; Galactogogue; Diosgenin and trigonelline

Abbreviations: NaAD: Nicotinateadenine Nucleotide; NaMN: Nicotinate Mononucleotide; NaR: Nicotinateriboside; NMN: Nicotinamide Mononucleotide; NR: Nicotinamideriboside; PPI: Pyrophosphate; PRPP: 5-Phosphoribosyl-1-Pyrophosphate; DM: Diabetes Mellitus; SAM: S-Adenosyl-L-Methionine; PNC: Pyridine Nucleotide Cycle

Constituents of Fenugreek and their uses

Saponins are amphipathic glycosides having hydrophilic glycoside moieties combined with a lipophilic triterpene derivative. The glycoside free (aglycone) portion of the saponin is termed as sapogenins. There are different sources of saponins and one of the chief source is fenugreek. Fenugreek contains approximately 4 to 8% saponins and about 1% alkaloids. The main steroidal sapogenins obtained from fenugreek seeds are diosgenin and yamogenin which are used as steroid intermediates in the pharmaceutical industry. The occurrence of diosgenin [(25R)-spirost-5-en-3 β -ol] in the seeds of fenugreek has been well expected for over 50 years [15]. Other saponins and steroidal saponins present in fenugreek include fenugrin B, fenugreekine, trigofenosides A-G, tigogenin, neotigogenin, gitogenin, neogitogenin, yuccagenin and saponaretin [16]. The plant alkaloid Trigonelline (0.3-0.4%) was first isolated from the seeds of fenugreek. It is a pyridine alkaloid, known for its hypoglycaemic and hypocholesterolemic activity. Trigonelline (N-methylnicotinic acid) is derived from nicotinic acid and

the reaction is catalysed by S-adenosyl-L-methionine (SAM)-dependent nicotinate enzyme N-methyltransferase. Nicotinamide and nicotinic acid, the products of pyridine nucleotide cycle (PNC) give rise to trigonelline. The synthesis of trigonelline from nicotinamide mononucleotide (NaMN) is shown in the Figure 2. Other alkaloids present in fenugreek include Choline, Gentianine, Carpaine and Betain [16-18].

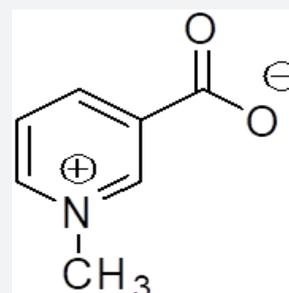


Figure 1: Structure of trigonelline.

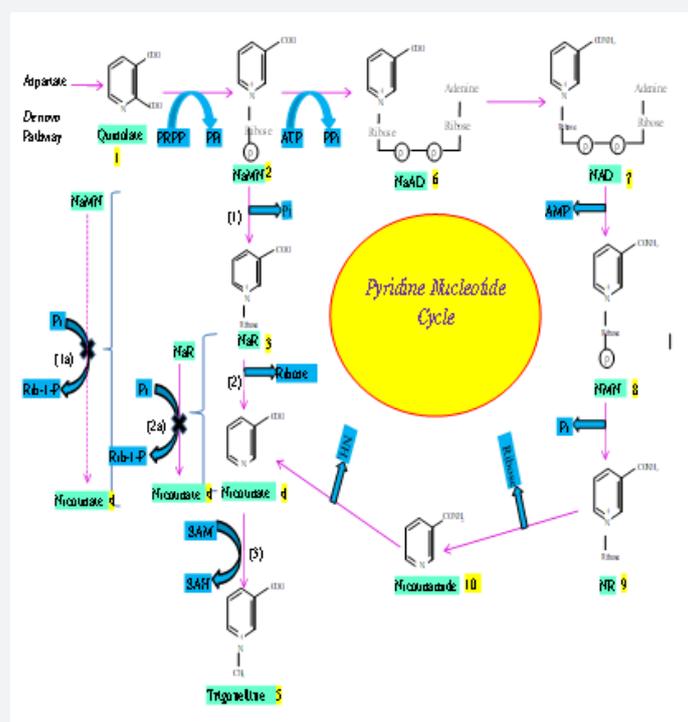


Figure 2: Proposed pathway of trigonelline (5) synthesis from NaMN (2). Steps 1-3 are respectively catalysed by NaMNNucleotidase, NaRnucleosidase and trigonelline synthase. The alternative enzymes, nicotinatephosphoribosyltransferase or NaMNglycohydrolase (reaction is not shown), might participate in the step 1a, and nucleoside phosphorylase in step 2a, although no evidence was obtained here. Trigonelline (5) synthesis via the pyridine nucleotide cycle is also shown.

Various amino acids have been found to be present in fenugreek which includes 4-Hydroxyisoleucine, Histidine, L-tryptophan, Arginine, Isoleucine, Leucine and lysine [19]. Flavonoids constitute about 100 mg/g of fenugreek seed such as apigenin, luteolin, orientin, quercetin, vitexin and isovitexin [20,21]. Fenugreek is abundant in polyphenolic compounds. 4-Hydroxyisoleucine (4-OH-Ile) is known to be present only in plants and is particularly plentiful in the seeds of fenugreek, where it comprises almost 80% of the total content of free amino acids. The amino acid, 4-OH-Ile stimulates the release of insulin and controls blood sugar levels [3].

The seeds of fenugreek are rich source of vitamins namely choline, vitamin A, B1, B2, C, nicotinic acid and niacin, biotin, calcium pantothenate, pyridoxine, vitamin C and cyanocobalamine [22]. They also contain significant amount of minerals like sulphur, phosphorus [23] and calcium [24]. Besides above, fenugreek contains a lot of other useful products and compounds like fiber (galactomannans), natural antioxidants and flavonoids etc [25-27].

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