



IJPPR

INTERNATIONAL JOURNAL OF PHARMACY & PHARMACEUTICAL RESEARCH  
An official Publication of Human Journals

ISSN 2349-7203





Human Journals

Review Article

October 2023 Vol.:28, Issue:3

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## Review on Phytochemical and Pharmacological Activities of *Trigonella foenum-graecum* Leaves

	
<b>IJPPR</b> INTERNATIONAL JOURNAL OF PHARMACY & PHARMACEUTICAL RESEARCH An official Publication of Human Journals	ISSN 2349-7203
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<b>Submitted:</b>	18 September 2023
<b>Accepted:</b>	23 September 2023
<b>Published:</b>	30 October 2023

**Keywords:** Fenugreek, bioactive composites, emulsifying agent, medicinal and nutraceutical goods.

### ABSTRACT

*Trigonella foenum-graecum* (TFG) generally known as Methi is a periodic condiment belonging to the family Fabaceae. It is cultured worldwide as a semiarid crop, and its seeds are a shared component in dishes from the Amerind key. TFG is a prehistoric medicinal herb used broadly worldwide as nutrition a well as in medicine. It can be produced on a wide series of soils. The supreme soil for methi is mud loam. The favourable soil pH is 6-7. In Ayurveda, fenugreek is well described in the name "*Methika*" with its therapeutic abilities as medicine, used as a lone herb and also part of numerous polyherbal combinations. In North Africa, southern Europe & Asia fenugreek was habitually used for diabetes and to improve lactation in women who were breastfeeding. Seeds have strong odour and slight bitterness in taste. Its seeds & leaves are rich sources of protein salutary fibre, vitamins, iron and several other salutary minerals. It is known for its medicinal qualities such as antidiabetic, antiallergic, anticarcinogenic, hypocholesterolemic, antioxidant, hepatoprotective and immunological activities. Near its medicinal value, it is also used as a part of several diet produce developments as food stabilizer, emulsifying agent & adhesive. This review presents the major medicinal and other salutary uses of fenugreek discovered through last numerous times of exploration in beast and mortal subjects as well as in other experimental studies. In this appraisal, we will describe nutraceutical, nutraceutical, antioxidant & medicinal belongings of TFG.



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## INTRODUCTION

TFG is an annual plant in the family Fabaceae, with greens entailing three minor oblongs to obovate leaflets. It is sophisticated worldwide as a semiarid crop. Its seeds and leaves are mutual elements in plates from the Indian subcontinent and have been used as a culinary ingredient since antique times.<sup>[1]</sup>

Although sold as a dietary supplement, commonly used in traditional & ancient medicine fenugreek is taken orally for digestive problems such as loss of appetite, constipation & gastritis. It is also used in the treatment of diabetes, polycystic ovarian diseases [PCOD], obesity & painful menstruation. The leaves of fenugreek are helpful for both external & internal inflammation and burns & also applied to avert hair fall.<sup>[2]</sup>

### Taxonomical/ Scientific Classification

Kingdom: Plantae

Order: Fabales

Family: Fabaceae

Subfamily: Faboideae

Genus: Trigonella

Species: *T. foenum- graceum*



Fig 1: Seeds



Fig 2: Leaves

## Production

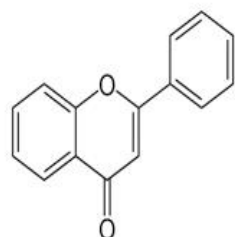
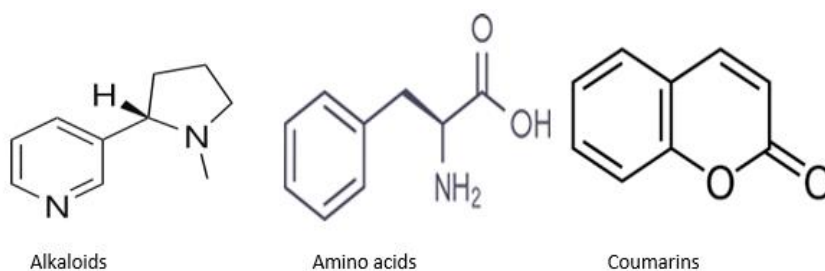
India is a foremost producer of fenugreek and concluded 80% of India's yield is from Rajasthan.

## Leaves

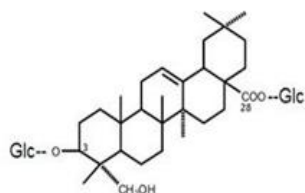
Fenugreek leaves are herbs with extensive medicinal properties. They specifically contain anti-carcinogenic & anti-inflammatory qualities. They improve digestion, skin, hair health & heart health. The leaves contain seven saponins, known as graecunin's. These compounds are glycosides of diosgenin. Leaves cover about 86.1% moisture, 0.9% fat, 4.4% protein, 1.1% fibre, 1.5% minerals, & 6% carbohydrates. The mineral and vitamins present in leaves include zinc, calcium, iron, riboflavin, carotene, niacin & vitamin C [3] found that fresh leaves of fenugreek contain ascorbic acid of about 220.97 mg per 100 g of leaves and  $\beta$ -carotene is present about 19 mg/100 g. On the other side, it was labelled that 83% & 84% ascorbic acid remained abridged in sun-bathe & oven-dried fenugreek leaves correspondingly. [4]

**Table 1: Composition of the *Fenugreek foenum graecum***

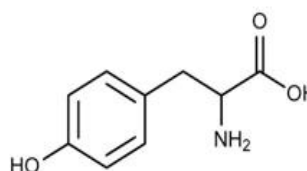
Components	Quantity
Protein	23g
Carbohydrates	58g
Fat	6.41g
Energy	32.3kcal
Dietary Fiber	24.6g
Calcium	176mg
Iron	33.53mg
Copper	1.11mg
Magnesium	191mg
Potassium	770mg
Sodium	67mg
Zinc	2.50mg
Vitamin's	A, B & C



Flavonoids



Saponins



Proteins

Phytochemical Constituents of *Trigonella foneum graceum* Leaves Extract <sup>[5]</sup>

**Table 2: Phytochemical Constituents**

S.no.	Chemical Constituents
Alkaloids	Trimethylamine, Neurin, Trigonelline, Choline, Gentianine, Carpaine & Betain
Amino Acids	Isoleucine, 4-Hydroxyisoleucine, Histidine, Leucine, Lysine, Arginine
Fibre	Gum, Neutral Detergent Fibre
Lipids	Triacylglycerols, Diacylglycerols, Monoacylglycerols, Free Fatty Acids.
Flavonoids	Quercetin, Rutin, Vitexin, Isovitexin
Saponins	Graecunins, Fenugrin B, Fenugreekine, Trigofenosides A-G
Steroids	Yamogenin, Diosgenin, Smilagenin
Others	Coumarin, Lipids, Vitamins, Proteins & Minerals

### **Health Benefits of Fenugreek Leaves:**

Fenugreek leaves are herd's extensive medicinal properties. They help in the treatment of many diseases such as following below.

#### **Anti-Hyperlipidaemia Activity**

High cholesterol levels causing disease like atherosclerosis, which occur due to build-up of fat deposits with in arteries, obstructing blood circulation, as a result lead to stroke, heart failure & high blood pressure. Studies suggest that intake of TFG leaves helps reduce cholesterol. They do so by dipping the issue of immoral cholesterol in the form. As a result, prevents heart disease. However, fenugreek also increases good cholesterol levels.<sup>[6]</sup>

#### **Anti-Obesity Activity**

Obesity and morbid weight gain lead to numerous diseases. Some of the prominent ones are heart disease and diabetes. In many cases obesity occurs due to overeating. However, lessons show that fibre helps in heaviness. Since fenugreek is high in fibre it is known for its satiating properties as a result it ultimately helps control cravings. Additionally, it keeps you from over eating and help to lose weight.<sup>[7]</sup>

#### **Anti-Inflammatory Activity**

Fenugreek is rich source of antioxidants. They contain vitamin A, C & beta carotene. Free radicals in the body results from poor metabolism, which unfortunately damages cells and organs in the human anatomy. This cell injury triggers many disorders. The antioxidants in fenugreek can prevent cell damage by free radicals & thus, infections, inflammatory conditions, cancer etc. some studies demonstrate that fibre in fenugreek is exceptionally beneficial<sup>[8]</sup>.

#### **Anti-Diabetic Activity**

Diabetes is a predominant Life disease that occurs due to numerous factors. Some common cause are improper diet and genetics if it worsens, it results in many adverse outcomes nephropathy neuropathy delayed healing Research suggest that fenugreek help to regulate glucose.4HO-Ile is an amino acid existing in fenugreek with Anti Diabetic properties. It stimulates insulin secretion and increases insulin sensitivity therefore this helps to maintain study black Glucose levels. Thus, fenugreek can benefit in the inhibition of type-2 diabetes.

### **Anti-Cancer Activity**

Several factors cause cancer. It includes the increase of cells beyond normal levels, which can occur due to oxidative stress Heredities etc., fenugreek might have latent anti-carcinogenic assets. fenugreek inhibits cancer cells growth. The study reveals that it may be effective and colon and prostate cancer. Moreover, they have exposed to extraordinary therapies in leukaemia & bone cancer.

### **Anti-Microbial Activity**

Fenugreek extract has antimicrobial properties and thus, limits the multiplication of bacteria. Therefore, it bids fortification against high potent bacteria. Studies demonstrate that defensin is another obliging module in fenugreek. It inhibits the proliferation of fungus. The antibacterial properties also progress wound healing.

### **Nephrolithiasis Activity**

Kidney stones result from improper dietary habits. It also occurs due to other factors like calcium hydroxyproline, and Oxalic acid. Training shows that antioxidants avert kidney stones the antioxidant in fenugreek can help reduce the level and to avoid kidney stones from forming. Additionally, the anti-inflammatory properties in fenugreek. It inhibits calcium deposition in the Kidney which prevent the renal tissue injury. <sup>[9]</sup>

### **Hepatoprotective Activity**

Fenugreek may diminish the radical cell grievance in the liver malt & unhealthy diet may remain liver impairment. The resultant damage may be Liver cirrhosis. Studies show that fenugreek May reduce the risk of cirrhosis by reducing the activities of enzymes. There by protecting the liver from damage.

### **Prevents Gastric Disorder**

Investigate shows that fibre in fenugreek works as diet to the responsive gut microbes. They absorb water from the intestine and soft and the bowel. Therefore, this makes it easier to exert them full stop fenugreek leaves also help in preventing indigestion. In addition, it reduces the risk of inflammation and constipation.

### **Prevents Clotting Disorders**

Fenugreek contains phenols it is a potent antioxidant that helps in preventing blood clots formation. Blood clots obstruct blood circulation interrupting the blood supply to the vital organs. Inappropriately, This, eventually even leads to vascular disorders.

### **Skin & Hair Health**

Fenugreek leaves comprise vitamin C it owns antioxidant properties that prevent inflammatory diseases it also inspires collagen fusion that gives determination to your skin. Thus, it prevents wrinkles and also delay is a sign of ageing. Full stop it also has healing properties it contains you late and can even moisturize dry skin Omega 36 fatty acid prevent follicle inflammation which prevent hair loss they also promote hair growth fenugreek has protein and nicotinic acid content therefore the correct dietary usage may help prevent hair fall and dandruff.

### **Bone Health**

Fenugreek is a rich source of calcium, Vitamin D and magnesium. They are essential for bone health. They support the bones & excite bone therapeutic. Therefore, they can avert bone ailments as an effect this include osteoporosis & ruptures. Diosgenin is a composite in fenugreek. Research that it restricts the synthesis of Osteoclasts may be bone -resorbing cells which means they break bone tissues. Their prominent during osteoporosis-a disorder that make your bone fragile and prone to fracture.<sup>[10]</sup>

### **Female Reproductive Health & Lactation**

Studies show that fenugreek can ease the menstrual cycle during regular periods. It helps in uterine contractions and regulates your menstrual periods. In addition, they might recover the indications related to menstrual issues such as fatigue. Fenugreek contains phytoestrogen and diosgenin, which mimic the female hormone oestrogen. However, the exact mechanism is unknown. Also, several studies have found fenugreek to improve breast milk production.<sup>[11]</sup>



**Table 3: Ethnomedical Uses of *Trigonella foenum-graecum*.**

S.NO	Activity	Extract	Parameters Assessed	Conclusion	Ref
1.	<b>Antibacterial &amp; Anti-Oxidant Activities</b>	Chloroform, hexane, methanol, ethanol & water	Total phenolic content (TPC), total flavonoid content (TFC), antibacterial screening, anti-oxidant activity assays- ferrous reducing antioxidant power assay, 2,2-diphenyl-1-picrylhydrazyl (DPPH) assay, lipid peroxidation inhibitory activity, superoxide radical scavenging activity	The results revealed that the level of polyphenols in the ethanol extract was 4.9 mg g <sup>-1</sup> which was higher when compared to other tested solvents.  Antibacterial activity: in ethanol extract with zones of inhibition 12±0.8 mm, respectively. The least inhibition was observed with aqueous extract.	12
2.	Antibacterial & Antifungal Activity	Hexane, ethyl-acetate, methanol & distilled water.	preliminary phytochemicals analysis, bioautography Antibacterial activity, antifungal activity,	The inhibitory effect of <i>T. foenum-graecum</i> leaves extracts was found maximum on <i>S. marcescens</i> (ZOI = 12.33±0.57 mm and AI = 0.648) by aqueous extract The inhibitory effect of <i>T. foenum-graecum</i> leaves extracts was found maximum on <i>S. marcescens</i> (ZOI = 12.33±0.57 mm and AI = 0.648) by aqueous extract The inhibitory effect of <i>T. foenum-graecum</i> leaves extracts was found maximum on <i>S. marcescens</i> (ZOI = 12.33±0.57 mm and AI = 0.648) by aqueous extract	13



				<p>followed by inhibition of <i>Bacillus cereus</i> (ZOI = <math>11.50 \pm 0.50</math> mm and AI = 0.761) by the methanol extract.</p> <p>The inhibitory effect of <i>T. foenum-graecum</i> leaves extracts was found maximum on <i>S. marcescens</i> (ZOI = <math>12.33 \pm 0.57</math> mm and AI = 0.648) by aqueous extract followed by inhibition of <i>Bacillus cereus</i> (ZOI = <math>11.50 \pm 0.50</math> mm and AI = 0.761) by the methanol extract.</p> <p>The inhibitory effect of TFG was found maximum maximum on <i>S. marcescens</i> (ZOI = <math>12.33 \pm 0.57</math> mm and AI = 0.648) by aqueous extract followed by inhibition of <i>Bacillus cereus</i> (ZOI = <math>11.50 \pm 0.50</math> mm and AI = 0.761) by the methanol extract.</p> <p>The inhibitory effect of <i>T. foenum-graecum</i> leaves extracts was found maximum on <i>S. marcescens</i> (ZOI = <math>12.33 \pm 0.57</math> mm and AI = 0.648) by aqueous extract followed by inhibition of <i>Bacillus cereus</i> (ZOI =</p>	
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				<p>11.50±0.50 mm and AI = 0.761) by the methanol extract.</p> <p>The inhibitory effect of TFG extracts was found maximum on <i>S. marcescens</i> (ZOI = 12.33±0.57 mm by aqueous extract.</p>	
3.	Green Synthesis, Characterization, & Antimicrobial Activity	Aqueous	Biosynthesis of silver nanoparticles, Antimicrobial activity	Fenugreek leaf extract act as a reducing and stabilizing agent in the process of synthesizing [AGNPS]& has an antifungal, antibacterial agent.	14
4.	<i>In Vitro</i> A - Amylase And A-Glucosidase Inhibitory	Ethyl acetate, Aqueous	Determination of total phenolic compounds, total flavonoid content, porcine pancreatic amylase inhibitory, $\alpha$ -glucosidase inhibitory activity,	The percentage inhibition displayed by each extract was justified that only ethyl acetate extract showed prominent $\alpha$ -amylase inhibitory potential (64.55% at a concentration 250 $\mu$ g/ml). The percentage of inhibition ranged from 54.55% to 13.65% in case of ethyl acetate extract and 43.95% to 9.23% in the case of water extract.	15
5.	Anti-Inflammatory & Antipyretic Effects	Aqueous	Anti-inflammatory studies using paw edema model	The results indicate TFG leaves extract possess anti-inflammatory as well as antipyretic properties	16

6.	Urotoxicity Cyclophosphamide	Aqueous	Lipid peroxidation (LPO) and anti-oxidants in the urinary bladder, glutathione <i>s</i> -transferase (GST), glutathione reductase (GR), glutathione peroxidase (GP) & catalase (CAT)	TFG extract was evaluated by measuring (LPO) and anti-oxidants in the urinary bladder in mice.	17
7.	Antinociceptive Effects		Antinociceptive effects - tail-flick and formalin tests.	The extract of TFG leaves produces antinociceptive effects through central and peripheral mechanisms	18
8.	Malassezia Furfur	Aqueous & ethanol	Qualitative and quantitative phytochemical evaluation, antidandruff activity, skin irritation test accelerated stability test	The aqueous & ethanolic extract was found to be 1.33 and 1.31 g/mL, respectively.	19
9.	Anthelmintic Activity	Aqueous	Anthelmintic activity	Aqueous extract of fenugreek leaves was 144±15 minutes to paralyze and 224±10 minutes to death of the worm.	20
10.	Anti-Oxidant Activity	Hexane, ethyl acetate, & ethanol	Photochemical analysis and total flavonoid content, column chromatography (TLC), infrared (IR) and nuclear magnetic resonance (NMR) analysis, LC-MS-MS identification, and DPPH assay.	Hexane 2.869 Ethyl acetate 5.64 Ethanol 19.752 Hexane 2.869 Ethyl acetate 5.64 Ethanol 19.752  The result showed ethanolic yield at 19.75 followed by ethyl acetate & hexane	21

11.	Haematological	Ethanol & aqueous extract	Haematological analysis, determination of liver function parameter	From this study we support the use of alcoholic fenugreek leaf extract was more active against pathogenic bacteria than the watery fenugreek leaves extract and it may have a role in the treatment of some infectious diseases.	22
12.	Hepatoprotective Effect	Ethanol	Antioxidant's sod, catalase, GPX levels, AST, ALT, ALP.	In conclusion the ethanolic leaf TFG extracts afforded hepatoprotective action against paracetamol induced liver injury.	23

## CONCLUSION

Traditionally, fenugreek is used worldwide to treat gastrointestinal problems, reduce cholesterol, prevent respiratory problems, improve digestion, prevent anaemia, treat ulcers, promote cardiovascular diseases and control diabetes. It was reported to have anticancer, antimicrobial, antifungal, anti-inflammatory, antinociceptive, and anti-helminthic activities. Literature also demonstrates its potential in the treatment of *Malassezia furfur* and urotoxicity. The activities reported for fenugreek leaves can be attributed to the phytochemicals with antioxidant properties present in the leaves. Based on many past conveyed methodical findings, fenugreek can be optional and necessarily be occupied as a portion of our regular diet as its generous use is safe and various health benefits can be strained from this natural basil. The above-mentioned revisions on fenugreek advise that the functional, nutritive & beneficial role of fenugreek leaves can be therapeutically exploited to develop promising nutraceuticals and supplements that can alleviate various diseases.

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