



AMAZING HEALTH BENEFIT OF FENUGREEK (*trigonella foenum-graecum* LINN.)

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Abstract

Fenugreek is known for its medicinal qualities such as antidiabetic, anticarcinogenic, hypocholesterolemic, antioxidant, and immunological activities. Beside its medicinal value, it is also used as a part of various food product developments as food stabilizer, adhesive, and emulsifying agent. More importantly it is used for the development of healthy and nutritious extruded and bakery product. The main chemical components of fenugreek are fibers, flavonoids, polysaccharides, saponins, fixed oils and some identified alkaloids. Mature seeds mainly contain amino acid, fatty acid, vitamins, saponins and a large quantity of folic acid. It also contains disogenin, gitogenin, neogitogenin, homorientin saponaretin, neogigogenin, and trigogenin. The endosperm of the seed is rich with galactomannan. The young seeds mainly contain carbohydrates. In this review paper, the potential of fenugreek for disease prevention and health improvement has been emphasized.

Keywords

Diabetes; Fenugreek Lactone, Dietary fibres, Nutraceutical, Hypoglycemic, Gum extrudate.

INTRODUCTION

Fenugreek (*Trigonella foenum-graecum*) is a leguminous, herbaceous, rainfed crop included among the seed spices is about 30-60 cm tall, leaflets are about 2-2.5 cm long, flowers are 1-2 cm long, axillary, sessile and cultivated throughout the country and has been used as a spice throughout the world to enhance the sensory quality of foods. Fenugreek, a short-living, self-pollinating crop, is a native to Indian subcontinent and the Eastern Mediterranean region. It belongs to Fabaceae family and is used extensively in various parts of the world as herb, food, spice, and traditional medicine. It is an annual herb with white flowers and hard, yellowish brown and angular seeds, known from ancient times, for nutritional value beside of its medicinal attributes. Fenugreek seeds are rich source of gum, fiber, alkaloid, flavonoids, saponin and volatile content. Due to its high content of fiber, fenugreek could be used as food stabilizer, adhesive and emulsifying agent to change food texture for some special purposes. The present article is aimed to review the potential applications of

fenugreek as a functional food and nutraceutical. This novel legume source provides soluble fiber along with other glucose-, cholesterol-, and triglyceride-lowering compounds. [1-3] This seed spice is employed for medicinal purpose in many traditional systems as antibacterial, gastric stimulant, against anorexia, antidiabetic agent and as a galactagogue. In recent decades, several health beneficial physiological attributes of fenugreek seeds have been seen in animal studies as well as human trials. Not only therapeutic, Fenugreek also used as spices worldwide. The leaves are used as green leafy vegetables in the diet. Fenugreek seeds are bitter in taste and have been in use for over 2500 years. In different languages it has different names, as Fenugrec (French), Methi (Hindi), Bockshorklee (German), Fienogreco (Italian), Pazhitnik (Russian), Alholva (Spanish), Koroha (Japanese), Hulba (Arabian), Halba (Malaya), and K'u -Tou (China). India is the major producer of Fenugreek and its main consumers are culinary and medicinal users. In the indigenous system, it is effective

against anorexia, and as gastric stimulant. Fenugreek having antidiabetic, antifertility, anticancer, antimicrobial, antiparasitic, lactation stimulant, hypocholesterolemic influence, antioxidant potency, digestive stimulant action, and hepatoprotective effect. [4-6] Among these beneficial

physiological effects, the antidiabetic and hypocholesterolemic property of fenugreek, both of which are mainly attributable to the intrinsic dietary fiber constituent, possess promising nutraceutical value, have been discussed in this comprehensive review paper.



Fig. 1: Phytochemistry and Pharmacology.

Plant-derived natural products have long-standing utility toward treating degenerative diseases. Fenugreek is considered as one of the oldest medicinal plants and its health-promoting effects have been cited in Ayurveda and traditional Chinese medicine. In recent decades, several health beneficial physiological attributes of fenugreek seeds have been seen in animal studies as well as human trials. These include antidiabetic effect, hypocholesterolemic influence, antioxidant potency, digestive stimulant action, and hepatoprotective effect. The investigations into the chemical composition and pharmacological actions have seen a renaissance in recent years. Extensive preclinical and clinical research have outlined the pharmaceutical uses of fenugreek as antidiabetic, antihyperlipidemic, antiobesity, anticancer, anti-inflammatory, antioxidant, antifungal, antibacterial, galactagogue and for miscellaneous pharmacological effects, including improving women's health. The pharmacological actions of fenugreek are attributed to diverse array of phytoconstituents. [5-8] The phytochemical analysis reveals the presence of steroids, alkaloids, saponins, polyphenols, flavonoids, lipids, carbohydrates, amino acids, and hydrocarbons. It is also used for conditions that affect heart health such as "hardening of the arteries" (atherosclerosis) and for high blood levels of certain fats including cholesterol and triglycerides. Fenugreek is used for kidney ailments, a vitamin deficiency disease called beriberi, mouth ulcers, boils, bronchitis,

infection of the tissues beneath the surface of the skin (cellulitis), tuberculosis, chronic coughs, chapped lips, baldness, cancer, Parkinson's disease, and exercise performance. Fenugreek has been associated with increased testosterone levels and enhanced sexual function in middle age men with androgen deficiency symptoms, as well as with a reduced severity of both menopausal symptoms and dysmenorrhea, including menstrual pain, fatigue, headache, nausea, and lack of energy. These hormone-regulating actions, equally beneficial for both men and women, are attributed to a high content of phytoestrogens (stearic acid, palmitic acid, and beta-sitosterol) and steroidal saponins (diosgenin, tigogenin, neotigogenin, and yamogenin). The presence of phytomenadione (a vitamin K derivative that aids coagulation), as well as alkaloids, amino acids (such as lysine), also contributes to the galactagogue, hypoglycemic, and hormone balancing properties of fenugreek. Additionally, fenugreek's omega-3 fatty acids and dietary fiber, as well as a water-soluble polysaccharide called galactomannan (Fig. 2), are thought to contribute with the beneficial effects of fenugreek on metabolic functions. Galactomannan has been shown to help regulate digestive enzymes, also inhibiting the absorption of glucose in the gastrointestinal tract. Fenugreek seeds contain no essential oil and their characteristic scent and flavor are due to the presence of fenugreek lactone (sotolone Fig. 3), an extremely powerful odorant agent. [6-9]

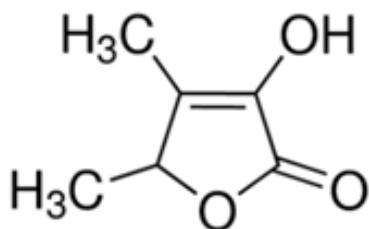


Fig. 2: Galactomannan structure

Fenugreek contains a number of chemical constituents including steroidal saponins. Diosgenin component has been found in the oily embryo of fenugreek. There are two furstanol glycosides, F-ring opened precursors of diosgenin that have been reported in fenugreek also as hederagin

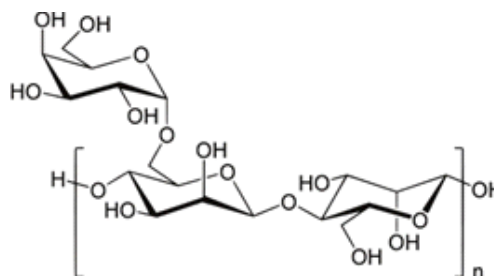


Fig. 3: Structure of Fenugreek Lactone

glycosides. Alkaloids such as trigocoumarin, nicotinic acid, trimethyl coumarin and trigonelline are present in stem. The mucilage is a standing out constituent of the seeds. There is about 28% mucilage; a volatile oil; 2 alkaloids such as trigonelline and Choline, 5% of a stronger-smelling, bitter

fixed oil, 22% proteins and a yellow coloring substance are present in stem. Fenugreek contains 23–26% protein, 6–7% fat and 58% carbohydrates of which about 25% is dietary

fiber. Fenugreek is also a rich source of iron, containing 33 mg/100 g dry weight. [10-14].

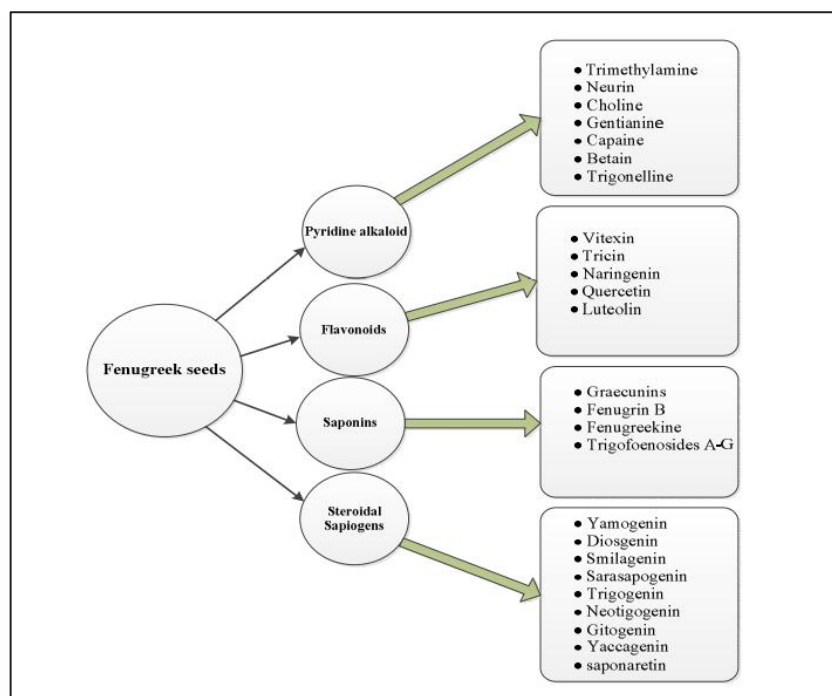


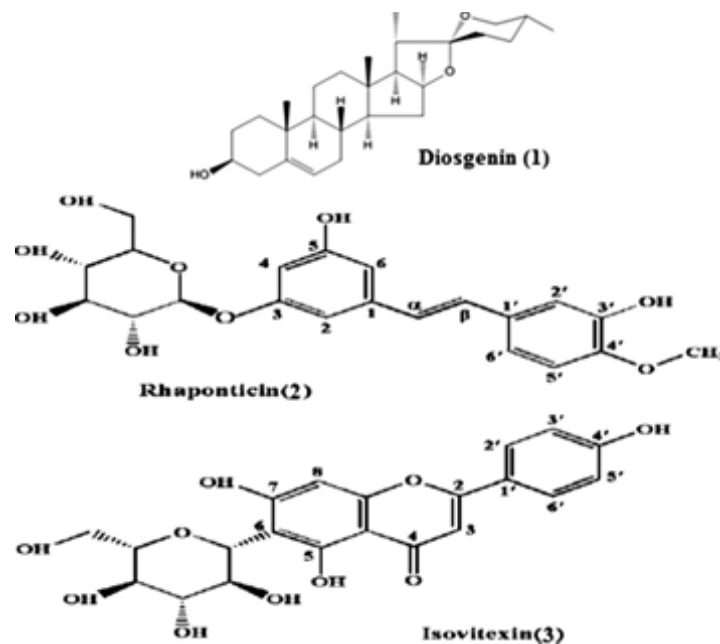
Fig. 4: Chemical constituents in fenugreek seeds.

The leaves contain seven saponins, known as graecunins. These compounds are glycosides of diosgenin. Leaves contain about 86.1% moisture, 4.4% protein, 0.9% fat, 1.5% minerals, 1.1% fiber, and 6% carbohydrates. The mineral and vitamins present in leaves include calcium, zinc iron, phosphorous, riboflavin, carotene, thiamine, niacin and vitamin C. It has been found that fresh leaves of fenugreek contain ascorbic acid of about 220.97 mg per 100 g of leaves and β -carotene is present about 19 mg/100 g. On the other side, it was reported that 84.94% and 83.79% ascorbic acid were reduced in sun and oven-dried fenugreek leaves respectively. Fresh leaves are used as vegetables in the diets. It was found that there was a better retention of nutrients in the leaves of fenugreek. Fenugreek is known for its pleasantly bitter, slightly sweet seeds. The seeds are available in any form whether whole or ground form is used to flavor many foods mostly curry powders, teas and spice blend. Fenugreek seed has a central hard and yellow embryo which is surrounded by a corneous and comparatively large layer of white and semi-transparent endosperm. The chemical composition of fenugreek (such as seeds, husk and cotyledons) showed that endosperm had the highest (4.63 g/100 g) saponin and (43.8 g/100 g) protein content. As against this, husk contains higher total polyphenols. The seeds of fenugreek contain about 0.1–0.9% of diosgenin and are extracted commercially. The plant tissue cultures from seeds of fenugreek when grown under optimal conditions have been found to produce as much as 2% diosgenin with smaller amounts of trigogenin and gitongenin. [12-16] Seeds also contain the saponin (fenugrin B). Fenugreek seeds have

been found to contain several coumarin compounds as well as a number of alkaloids (e.g., trigonelline, gentianine, carpaine). The large amount of trigonelline is degraded to nicotinic acid and related pyridines during roasting. The major bioactive compounds in fenugreek seeds are believed to be polyphenol compounds, such as rhaponticin and isovitexin. Small amount of volatile oils and fixed oil has been found in fenugreek seeds have found the odor active compounds based on the fenugreek aroma detection with the help of Gas Chromatograph and these includes the olfactometry diacetyl, 1-Octene-3-one, sotolon, acetic acid; 3-Isobutyl-2-methoxypyrazine, butanoic acid, isovaleric acid, 3-isopropyl-2-methoxypyrazine, caproic acid, eugenol, 3-Amino-4,5-dimethyl-3, linalool, (Z)-1,5-Octadiene-3-one, 4-dihydro-2(5H)-Furanone with characteristic aroma of buttery like, roasty/earthy, metallic, pungent, paprika like, sweaty/rancid, flowery, musty, spicy respectively. Out of all these volatile compounds, sotolon was reported to be found most predominantly in (5s)-enantiomeric form (95%) in fenugreek. A study was conducted on sweat of human after fenugreek ingestion and it has been concluded that compounds responsible for the strong maple-syrup odor present in sweat after fenugreek ingestion are due to the following components including the following: pinene; 3-octen-2-one, 2,5-dimethylpyrazine, β -; camphor; terpinen-4-ol; 4-isopropyl-benzaldehyde; neryl acetate and β -caryophyllene but it was observed that 2,5-dimethylpyrazine to be a major component responsible for sweat odor contributing compound. [15-18]

Table 1: Odorous chemical constituents occurring in aroma extract of fenugreek seeds.

Odorous compound	Aroma quality
1-Octen-3-one	Mushroom-like
(Z)-1,5-Octadiene-3-one	Metallic
3-Isopropyl-2-methoxy pyrazine	Roasty, earthy
Acetic acid	Acidic, pungent
3-Isobuty-2-methoxy pyrazine	Roasty, paprika-like
Linalool	Flowery
Butanoic acid	Sweaty, rancid
Isovaleric acid	Sweaty, rancid
Caproic acid	Musty
Eugenol	Spicy
3-Amino-4,5-dimethyl 3, 4-dihydro-2-(5H) furanone	Seasoning-like
Stolon	Seasoning-like

**Fig. 5: Chemical structures of (1) Diosgenin (2) rhaponticin and (3) isovitexin (Volatile contents)****Use of Fenugreek in Day to day life**

Methi seeds are a great remedy for diabetics. Methi helps in controlling the blood sugar level. The amino acid compounds in fenugreek seeds increase insulin secretion in the pancreas which helps in lowering the blood sugar level in the body. Consumption of fenugreek helps in treating kidney stones. Methi seeds help in improving kidney health. Drinking methi water will keep you full for long. Methi is packed with fiber which gives you a feeling of fullness. This helps you manage your weight. When you feel full, you don't eat many calories and also prevents you from bingeing on unhealthy snacks. It also prevents bloating. Fenugreek seeds have nutrients that help in hair growth. Consuming fenugreek water will promote hair growth, improve hair volume and keep hair problems such as dandruff, roughness at bay. Fenugreek or methi water helps in flushing out the harmful toxins from your body and it helps in improving your bowel movement. It helps you fight against digestive problems. It prevents constipation, indigestion among other digestion problems. [17-20] Methi is immensely useful for your skin and hair too.

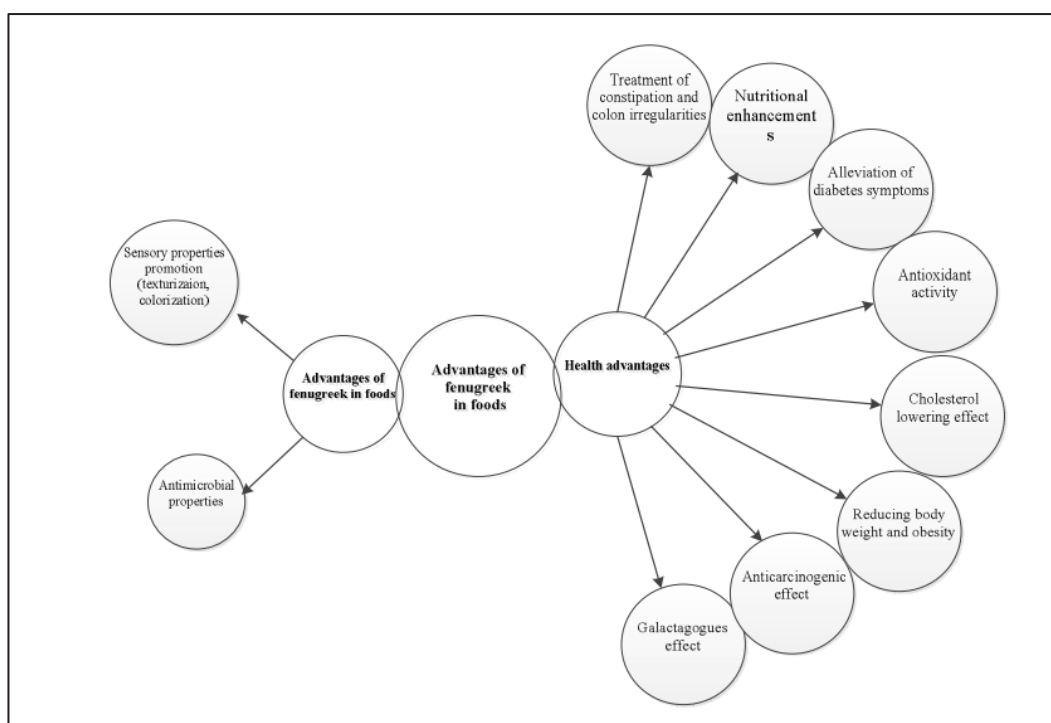
Fenugreek is taken for digestive problems such as loss of appetite, upset stomach, constipation, inflammation of the stomach (gastritis). Fenugreek is also used for painful menstruation, polycystic ovary syndrome, and obesity. Some men use fenugreek for hernia, erectile dysfunction, male infertility, and other male problems. Both men and women use fenugreek to improve sexual interest. Fenugreek is used for a variety of purposes. Fenugreek seed extract is the principal flavoring ingredient of simulated maple syrup. It is also used as a tobacco-flavoring ingredient, hydrolyzed vegetable protein flavor, perfume base, and a source of steroid saponin in drug manufacturing industries. The leaves are commonly consumed as a vegetable. [18-22] Currently, there is not enough conclusive evidence to fully support the use of fenugreek for any medical purpose. However, people have been using fenugreek in varying forms for hundreds or potentially thousands of years to treat a very wide range of conditions, such as: digestive problems, including constipation, loss of appetite, and gastritis; breast milk production and flow; diabetes; low testosterone or

libido; painful menstruation; menopause; arthritis; high blood pressure; obesity; breathing problems; boils; low exercise performance; ulcers; open wounds; muscle pain; migraines and headaches; childbirth pains; Of all the reported health benefits of fenugreek, only a few have been substantially backed by scientific evidence. Among other benefits, some research suggests that fenugreek may: Quite a few studies in animals have shown that at least four compounds in fenugreek have antidiabetic properties. They primarily: reduce intestinal glucose absorption; delay gastric emptying; improve insulin sensitivity and action; reduce concentrations of lipid-binding protein. Fenugreek may help stimulate breast milk production and ease the flow. Practitioners of traditional Asian medicine have long recommended fenugreek for this purpose. Fenugreek may suppress the appetite and increase feelings of fullness, which could help reduce overeating and lead to weight loss. Fenugreek may help increase low testosterone and sperm levels. Fenugreek may help regulate cholesterol levels and improve blood pressure, which can reduce the risk of

developing heart conditions and improve heart health. Fenugreek has long been used for pain relief in traditional systems of medicine. Researchers think that compounds called alkaloids in the herb help block sensory receptors that allow the brain to perceive pain. [19-23]

Traditional uses

The medicinal value of fenugreek seeds is mentioned in Ayurvedic texts as well as in Greek and Latin pharmacopoeia. The Ayurvedic texts praise this herb for its power as an aphrodisiac, but modern vaidyas seem to be using it more for digestive and respiratory problems stemming from an excess of kaph (phlegm) and vat (wind). In ancient Egypt, methi was used to ease childbirth and to increase milk flow, and modern Egyptian women are still using it today to relieve menstrual cramps, as well as making hilba tea out of it to ease other kinds of abdominal pain. The Chinese call it hu lu ba, and also use it for treating abdominal pain. Though this cool season crop is grown in most corners of the world, its uses and people's awareness of its value vary considerably.



In India, fresh methi ka saag (the stems and leaves of the plant) is very commonly cooked as a winter vegetable, and the seeds are used year-round as a flavoring agent for various dishes. The seeds are also eaten raw as sprouts and used medicinally. In Egypt and Ethiopia, methi is used in baking bread, and the Swiss use it for flavoring cheese. In the USA, it is mainly used to make spice blends for soups and stews. [22-24]The herb of fenugreek has been used for centuries as a cooking spice in European countries and it remains a popular ingredient in curry powders, pickles and spice mixtures in India Pakistan, Bangladesh and other Asian countries. Fenugreek has been used in the folk medicines for the treatment of cellulitis, boils, and tuberculosis. Fenugreek remained a key ingredient in a 19th century patent medicine

for dysmenorrheal and postmenopausal symptoms. It also has been recommended for the promotion of lactation. The seeds of fenugreek have been used as an orally as insulin substitute for reduction in blood glucose, and the extracts from seed have been reported to lower blood glucose levels. The maple aroma and flavor of fenugreek have led to its use in imitation maple syrup. [23-25]

Fenugreek usage in bakery and extruded products

The interaction of fenugreek protein with the food constituents determines its ability to stabilize and emulsify the food constituents. The effect of fenugreek gum on solubility and emulsifying properties of soy protein isolate has been evaluated and reported that the emulsifying activity

of soy protein isolate with fenugreek gum was four times higher than that of soy protein isolate with fenugreek gum or fenugreek gum alone and the results were to those of bovine serum albumin. The emulsifying stability of soy protein isolate with fenugreek gum dispersions was respectively three times higher than that of soy protein isolate with fenugreek gum and bovine serum albumin. Emulsifying properties and solubility of soy protein isolate with fenugreek gum dispersions were also stable over wide ranges of high temperature, pH and ionic strength. Fenugreek contains higher dietary fiber content which acts as probiotic in functional food. The soluble fiber of fenugreek acts as an excellent substrate for fermentation done by the microorganisms in the large intestine. The dietary fiber of fenugreek has potential for widespread use in the food industry because its galactomannan composition has emulsifying and stabilizing properties. Flour supplemented with a percentage of 8% and 10% of fenugreek dietary fiber has been used in the production of baked goods such as bread, pizza, muffins, and cakes. This application of fenugreek to flour allows for the production of functional foods that may be widely acceptable to consumers observing western diets. [24-26] Fenugreek paste, locally termed as "Cemen" is a popular food in Turkey which is prepared from ground fenugreek seeds. Crushed fenugreek seed or coarse fenugreek powder is used to make ball for making clarified butter. Adding fenugreek fiber to refined flours helps to fortify with a balance of soluble and insoluble fiber. Flour fortified with 8–10% fenugreek fiber has been used to prepare bakery foods such as pizza, bread, muffins, and cakes with acceptable sensory properties. Fenugreek seed husk is a rich source of dietary fiber and several important minerals. This fiber-rich functional ingredient can be incorporated in the manufacture of high-fiber muffins. The fiber-rich muffins possessed good volume, soft texture and medium-fine grain with twice the amount of DF incorporated fenugreek in bread and demonstrated that fenugreek in food helps in reduction of blood sugar but due to its bitterness and strong odor its use is restricted. They did not find significant variation in color, texture, proximate composition, firmness, and flavor intensity between the wheat and fenugreek bread, but level of glucose and insulin was found to be lower in the fenugreek bread. Fenugreek's functional property of reducing insulin resistance was maintained in the bread. Therefore, it is evident from this study that fenugreek can be incorporated in baked products in acceptable limit which will reduce insulin resistance and treat diabetic patients as well. Fenugreek flour has been incorporated up to a 10% level in the formulation of biscuits without affecting their overall quality. The physical, sensory and nutritional characteristics generally revealed that biscuits containing 10% germinated fenugreek flour were the best among all the composite fenugreek flour biscuits. Hence, development and utilization of such functional foods will not only improve the nutritional status of the general population but also helps those suffering from degenerative diseases. In a study incorporation of fenugreek flour up to 10% level has been used in the formulation of biscuits. [25-27] Baking quality, color attributes and organoleptic evaluation revealed

that wheat flour can be replaced using 10% Soaked Fenugreek and 20% Germinated Fenugreek flours to produce acceptable and high nutritional value biscuits. The study confirmed that fenugreek seed (raw, soaked and germinated) significantly reduced total lipids, serum total cholesterol, and LDL-cholesterol but non-significant changes in triglycerides and serum HDL-cholesterol were observed. It can be recommended that fenugreek may be used for lipid lowering purposes. Supplementation of basal diets with fenugreek leaves, seeds (dry and germinated) and wheat flour supplemented with germinated fenugreek powder at 5–10% levels increased the total proteins, fibers, iron, zinc, calcium, vitamin B2, carotene, vitamin E and vitamin C contents. These dietary supplements also improve the blood picture of anemic rats so they have nutritive and restorative properties. The daily use of fenugreek products as a dietary supplement is proved to be safe and healthy. Therefore, this study recommends that intake of fenugreek products may be beneficial for patients who suffer from iron deficiency anemia owing to their nutritive and restorative values. In the same way 10% germinated fenugreek seed flour has been incorporated into the wheat based biscuits formula resulted in improving their chemical and nutritional quality and additionally also complimented the deficiency of lysine, isoleucine, leucine, threonine and valine, and hence neutralizes the amino acid imbalance. Fenugreek seed flour and fenugreek leave powder have been used for the development of extruded snacks. In a study a mixture of about 1.78% fenugreek seed flour and 0.66% fenugreek leave powder with the base material was found to have high preference levels for parameters of physical, functional and color and could be extruded with acceptable quality characteristics. The effects of fenugreek flour and debittered fenugreek polysaccharide inclusion on the physical and sensory quality characteristics, and glycemic index (GI) of chickpea–rice based extruded products were studied. Due to the distinct bitter taste, inclusion of fenugreek flour was not acceptable at levels more than 2% in extruded chickpea based products. Addition of fenugreek polysaccharide resulted in slight reduction in radial expansion, while longitudinal expansion increased. Water absorption index increased while water solubility index decreased compared to the control. The mean scores of sensory evaluation indicated that all products containing fenugreek polysaccharide up to 15% were within the acceptable range. There were no significant differences between products containing 5–15% fenugreek polysaccharide in their color, flavor, texture and overall quality. Fenugreek, in the form of debittered polysaccharide could be incorporated up to a level of 15% in a chickpea–rice blend to develop snack products of acceptable physical and sensory properties with low GI. In another study fenugreek gum was extruded in a twin-screw extruder without an exit die to minimize a decrease in molecular weight of fenugreek gum during extrusion process. Both the steady and dynamic shear rheological tests revealed that extrusion process did not substantially influence the steady and dynamic shear properties of the gum. The power law model was applied to describe the flow behavior of the extruded gum solutions. The

extrusion modified fenugreek gum solutions exhibited a shear thinning flow behavior at 25 °C, and the values of consistency index and apparent viscosity increased with an increase in the gum concentration. The magnitudes of storage modulus and loss modulus for the extrusion modified fenugreek gum solutions increased with increasing frequency and with increasing gum concentration. Fenugreek gum (extruded and non-extruded) was substituted for wheat flour at 0%, 5% and 10% (w/w) and the rheological effects and bread making characteristics were determined. [22-26] Bread containing fenugreek gum (FG) at 5% and 10% showed volumes and texture comparable with control bread. Extruding FG also improved its solubility in bread. Fenugreek gum resulted in an increase in dough farinograph water absorption compared with the control, but extruding the gum caused an even greater increase in water absorption when compared with the non-extruded gum. The addition of FG to bread dough caused an increase in storage modulus (G') and loss modulus (G''). Starch pasting using RVA showed an increase in peak viscosity, final viscosity, breakdown and setback in a dose-related response when compared with a control. Another study showed the addition of fenugreek gum (FG) to the extruded pea-rice snack products. In addition to fenugreek gum, two more gums (guar gum and locust bean gum) were added to it. When these three gums were added to the formulations at levels of up to 20%, good expansion of the products occurred. The WAI of the extrudates containing FG increased with increasing inclusion levels. In addition to the high contents of starch that serve to provide energy, these snacks are good sources of protein and dietary fiber, and are low in fat, qualifying them as low GI snack products. In particular, the reduction in GI was the greatest with fenugreek gum extrudates. [23-29]

DISCUSSION AND CONCLUSION

Fenugreek is the famous spices in human food. The seeds and green leaves of fenugreek are used in food as well as in medicinal application that is the old practice of human history. Fenugreek seeds are rich with vitamin E. Fresh Fenugreek leaves are beneficial for indigestion, flatulence and in sluggish liver treatment. Regular use of fresh Fenugreek leaves paste helps hair grow, preserves natural color, keeps hair silky and also cures dandruff. Fenugreek Seeds made in gruel, are given to nursing mothers to increase the flow of milk and also reduce the amount of calcium oxalate in the kidney which causes kidney stones. In animal studies, Fenugreek appeared to lowering the chance of developing colon cancer by blocking the action of certain enzymes. Fenugreek is currently used as a source of the steroid diosgenin, one of its active constituent from which other steroids can be synthesized. Not only that Fenugreek has a broad range of pharmacological profile but also it has antidiabetic activity, antiplasmodic activity, hypolipidemic activity, immunological activity, antibacterial activity, anthelmintic activity, anti-inflammatory, analgesic activity and antioxidant activity. These beneficial physiological effects including the antidiabetic and hypocholesterolemic effects of fenugreek are mainly attributable to the intrinsic

dietary fiber constituent which have promising nutraceutical value. It has been used to increase the flavoring and color, and also modifies the texture of food materials. It is well known for its fiber, gum, other chemical constituents and volatile contents. Dietary fiber of fenugreek seed is about 25% which changes the texture of food. These days it is used as food stabilizer, adhesive and emulsifying agent due to its high fiber, protein and gum content. The protein of fenugreek is found to be more soluble at alkaline pH. Fenugreek is having beneficial influence on digestion and also has the ability to modify the food. Fenugreek has been found to have important bioactive compounds. From this review it was observed that fenugreek has been used as food stabilizer, food adhesive, food emulsifier and gum. Fenugreek has been used to produce various types of bakery products and extruded product. Based on these several health usefulness as discussed in review, based on various past reported scientific findings, fenugreek can be recommended and must be taken as a part of our daily diet as its liberal use is safe and various health benefits can be drawn from this natural herb. The above-mentioned studies on fenugreek suggest that the functional, nutritional and therapeutic characteristics of fenugreek can be exploited further in the development of healthy products. Wonderful functional and medicinal values of fenugreek are attributed to its chemical composition proteins, dietary fiber, mucilaginous soluble fiber, fixed fatty acids and essential oils, and steroidal saponins. Moreover, some minor components such as alkaloids (trigonelline, cholin, gentianine, carpaine, etc), free unnatural amino acids (4-hydroxyisoleucine), and individual spirostanols and furastanols like diosgenin, gitogenin and yamogenin have also been identified and determined as the main component for its various biological effects. Regarding the composition of fenugreek seeds, husk and cotyledons it has been reported that endosperm had the highest saponin and protein content, whereas husk had higher total polyphenols and total dietary fiber, comprising insoluble dietary fiber and soluble dietary fiber. It has been shown that fenugreek has antidiabetic, anticancer, hypocholesterolemic, anti-inflammatory, antioxidant and chemopreventive activity due to its useful chemical constituents. Fenugreek has strong flavor and aroma. The plants leaves and seeds are widely consumed in Indo-Pak subcontinent as well as in other oriental countries as a spice in food preparations, and as an ingredient in traditional medicine. A wide range of uses were found for fenugreek in ancient times. Medicinally it was used for the treatment of wounds, abscesses, arthritis, bronchitis, ulcer and digestive problems. Traditional Chinese herbalists used it for kidney problems and conditions affecting the male reproductive tract. Fenugreek was, and remains, a food and a spice commonly eaten in many parts of the world. Among the spices, the Fenugreek is used as esoteric food adjacent to enhance the flavor and colour of the food and make it tasty and also used to modify the texture of food. The seeds and plants are basically hot and dry and also they are suppurative, aperient, and diuretic. They have some useful aspect in dropsy, chronic cough, enlargement of the liver and the spleen. The leaves of Fenugreek is useful for both internal and

external swellings and burns and also used to prevent the hair falling off. The seeds are considered as carminative, tonic and aphrodisiac. Fenugreek is used to ease child birth as well as it helps to increase the milk flow of mother. Egyptian women are still taking Fenugreek for menstrual pain and tourist use it as hilba tea to remove stomach problem. Not only that the plant is also recommended for use in dyspepsia with loss of appetite, in diarrhea of puerperal women, and in rheumatism. An infusion of seeds is given to small-pox patients as a cooling drink. Fenugreek seed contains various bioactive compounds like flavonoids (quercetin, rutin, vetexin), saponins (graecunins, fenugrin B, Fenugreekine), amino acids (isoleucine, 4-hydroxyisoleucine, histidine, leucine, lysine). As medicinal plant it shows its activity against allergies, appetite / loss of catarrh, bronchial, cholesterol, diabetic retinopathy, gas, gastric disorders, lung infections, mucus excessive, throat/sore, abscesses, anemia, asthma, boils, body odour, bronchitis, cancer, swollen eyes, fevers, gallbladder problems, heartburn, inflammation, sinus problems, ulcers, uterine problems etc. A study in India showed that Fenugreek seed is used to reduce the blood sugar and other harmful fats. The evidence to date suggests that fenugreek can be a potential natural health product for the prevention and treatment of type II diabetes. This novel legume source provides soluble fiber along with other glucose-, cholesterol-, and triglyceride-lowering compounds. It would be a significant contribution to the daily management and stabilization of blood glucose and lipid levels for non-insulin-dependent diabetics. Fenugreek has antioxidants and anti-inflammatory properties. Among the spices that are esoteric food adjuncts being used to enhance flavoring and color, fenugreek also modifies the texture of food. This seed spice is also employed for medicinal purpose in many traditional systems as antibacterial, gastric stimulant, against anorexia, antidiabetic agent and as a galactagogue. It is important to increase awareness of the public, dieticians, and other health professionals as to the unique properties of fenugreek and to recommend it for the prevention of hyperglycemia and hyperlipidemia.

Has been resurgence in the consumption and demand for medicinal plants. Medicinal plants are finding use as Pharmaceuticals, Nutraceuticals, Cosmetics and Food supplements.

Even as Tradicional source of medicinal and they continue to play pivotal role. Fenugreek was used to ease childbirth and to increase milk flow. It is still taken by Egyptian women for menstrual pain and as hilba tea to ease stomach problems of tourists. Seed of fenugreek contain Flavonoids like quercetin, rutin, vetexin, saponins like Graecunins, fenugrin B, fenugreekine, Amino acids like as Isoleucine, 4-Hydroxyisoleucine, Histidine, Leucine, lysine, Alkaloid- trigonellin, it also contain mucilage, sugars, an.. Medicinal Action and Uses of Fenugreek like Allergies, Appetite/loss of Catarrh/bronchial, Cholesterol/high, Diabetic Retinopathy, Gas, Gastric Disorders, Lung Infections, Mucus

Excessive, Throat/sore, Abscesses, Anemia, Asthma, Boils, Body Odour, Bronchitis, cancer, Eyes/swollen, Fevers, Gallbladder Problems, Heartburn, Inflammation, Sinus Problems, Ulcers, Uterine Problems, Water Retention focused the investigator's attention on this plan.

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