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COMPLETE UTILIZATION OF FENUGREEK SEEDS CONSTITUENTS FOR CURING COMMON HUMAN PROBLEMS

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ABSTRACT
In Indian homes, herbs are highly valued for their medical properties. When their active ingredients are produced, they have been shown to arrest, diminish, and end the majority of diseases. Trigonella has been present on the continents of Asia, Europe, Africa, and Australia since prehistoric times. The species name "foenum-graecum" (meaning "Greek hay") suggests that it was once used as a feed crop. Traditionally, Trigonella foenum-graecum was used to cure a variety of illnesses. In addition to its medicinal properties, which include antidiabetic, anticarcinogenic, hypocholesterolemic, antioxidant, and immunological activities, fenugreek (Trigonella foenum-graecum) is a legume that has been used as a spice to improve the sensory quality of foods throughout the world. It is also used as an adhesive, emulsifying agent, and food stabilizer in the development of various food products, but most significantly, it is used to create wholesome and nourishing extruded and baked goods.Fenugreek (Trigonella foenum-graecum L.) is frequently used in Ayurvedic and Traditional Chinese medicine because of its many health advantages. Numerous substances, including alkaloids, amino acids, coumarins, flavonoids, saponins, polyphenols, carbohydrates, vitamins, and other bioactive substances, are found in its leaves and seeds.
KEYWORDS - *Fenugreek ,Trigonella foenum graceum,nutracuticals, Antioxidant, Antidiabetic, digestive stimulant, Anticancer, medicinal uses.*

REVIEW OF LITERATURE

1)Rashid R. Ahmad H. Ahmed Z et.al(2) -There are several uses for fenugreek as a spice, herb, food, and medication. Its active ingredients—galactomannan, trigonelle, diosgenin, and 4-hydroxyisoleucine—have a noticeable impact on diabetes management. In newly diagnosed type-2 diabetics, the impact of galactomannan derived from fenugreek on lipid profile, HbA1c, and fasting blood glucose was noted. Newly diagnosed type-2 diabetics (n = 64) were the subjects of a 12-week interventional randomized, single blind control research with a 4-week washout period. The group (n = 32) was given 1 gm/day of galactomannan following a rigorous randomization trial, whereas the control group (n = 32) was given a placebo. Three measurements of fasting blood glucose, HbA1c, and lipid profile were made: once at baseline, once after 12-weeks, and once following a 4-week washout period. Each variable's mean and SD were determined. Fasting blood glucose, HbA1c, total cholesterol, triglycerides, and low-density lipoprotein all significantly decreased in the study group. The high density lipoprotein did not increase considerably, although it did improve. The findings imply that low doses of galactomannan may be utilized as an alternate treatment for newly diagnosed type-2 diabetics to control their hyperglycemia and dyslipidemia.

2) Sajad Ahmad wani et.al(5) -Trigonella foenum-graecum, sometimes known as fenugreek, is a legume that has been used as a spice to improve the flavor of meals all over the world. It is well recognized for its therapeutic properties, which include immunological, antioxidant, hypocholesterolemic, anticarcinogenic, and antidiabetic effects. In addition to its therapeutic benefits, it is utilized as an emulsifying agent, food stabilizer, and adhesive in a variety of food product advancements. More significantly, it is employed in the creation of wholesome and nourishing extruded and baked goods. The current study examines the nutraceutical qualities of fenugreek and how it is used in different product development.

3)Uma maheshwari shrinivas et.al(15)- The seeds of fenugreek (Trigonella foenum-graecum L.) are used extensively in both traditional medicine and culinary dishes. The bioactive components of fenugreek, including diosgenin, 4-hydroxyisoleucine (4-HIL), trigonelline, galactomannan (GM), and polyphenols like quercetin, are typically responsible for its biomedical properties. Fenugreek seeds have been shown to have positive effects on a number of physiological markers associated with diabetes mellitus (DM). They also

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have a role as a dietary modulator on metabolism, physiology, and biological mechanisms of action that are pertinent to DM and other lifestyle diseases. Antioxidation, immunomodulation, inflammation, digestive stimulation, antibacterial activity, and galactagogue are further aspects of its nutraceutical qualities. Consequently, fenugreek seed is a miracle spice.

4)Nasim khorshidian et.al(14)- Native to southern Europe and Asia, fenugreek (Trigonella foenum graecum) is an annual herb with white flowers and firm, angular, yellowish brown seeds. In addition to its therapeutic benefits, fenugreek has long been valued for its nutritional content. Gum, fiber, alkaloids, flavonoids, saponins, and volatile content are all abundant in fenugreek seeds. Because of its high fiber content, fenugreek can be used as an adhesive, food stabilizer, and emulsifying agent to alter the texture of food for certain uses. Fenugreek may also be considered an antidiabetic, anticarcinogenic, antioxidant, antibacterial, antianorexic, and stomach stimulant, according to some data. It may also be used as a treatment for hypocholesterolemia and hypoglycemia. Reviewing fenugreek's possible uses as a nutraceutical and functional food is the goal of this essay.

INTRODUCTION

Fenugreek, or Trigonella foenum graecum, is a member of the Fabaceae family. This herb has medicinal properties and is used to treat a wide range of illnesses, including cancer, diabetes, inflammation, hypercholesterolemia, reproductive issues, and neurological diseases. Fenugreek seeds have been used as stomachic, expectorant, demulcent, carminative, and laxative for ages [1].Though it was first cultivated in Eastern Europe, it is now grown throughout. The phytochemicals that give it its pharmacological properties include flavonoids, alkaloids, coumarins, vitamins, carbohydrates (galactomannan), saponins, diosgenin, trigonelline, and soluble fibers. Its anti-diabetic, anti-sterility, and anti-fertility actions have been demonstrated in a number of clinical and pre-clinical investigations. Additionally, it controls the synthesis of enzymes that lower cholesterol and manage blood sugar levels[2].In order to lessen oxidative stress, it also controls detoxifying and antioxidant enzymes. Fenugreek's flavonoids and saponins stop the creation of carcinogen-DNA adducts, which in turn prevents the genesis of tumors[3].It is known by several names in several languages, including Fieno greco (Italian), Bockshorklee (German), Methi (Hindi), Fenugrec (French), Alholva (Spanish), Koroha (Japanese), Halba (Malaya), Hulba (Arabic), and Pazhitnik (Russian)[4].Fenugreek seed contains roughly 25% dietary fiber, which modifies food texture. Because of its high fiber, protein, and gum content, it is utilized as an emulsifying agent, glue, and food stabilizer these days. It is discovered that fenugreek protein is more soluble at alkaline pH levels[5].It has a wealth of minerals and other beneficial components, including steroidal saponins and protein, vitamin C, niacin, potassium, diosgenin, alkaloids, lysine, and L-tryptophan[6].Fenugreek has long been known to have health benefits when consumed as vegetables, food supplements, or medical treatments. Although it has been utilized by numerous cultures, Asia and the Mediterranean region have been its primary users[7].Diosgenin increases apoptosis, inhibits proliferation, and inhibits invasion brought on by tumor necrosis factor. Sperm cell count, motility, and total and free testosterone can all be increased by fenugreek seeds, which benefits both sexual and physical health[8].Fenugreek is a winter crop, so it can withstand cold temperatures and frost. It grows best in areas with moderate to low rainfall, and it performs best in loam and clayey loam soils with adequate drainage[9].

Nutritional Information

One tablespoon, or 11 grams (g), of whole fenugreek seeds contains 35 calories and several nutrients, including :

Nutritional Information	Percentage
Fiber	3g
Protein	3g
Carbs	6g
Fat	1g
Iron	21% of the Daily value (DV)
Manganese	6% of the DV
Magnesium	5% of the DV
Phosphorous	3% of the DV

Table no :1(Nutritional information about Fenugreek)

Fenugreek Seeds

Fenugreek seeds are used in relatively larger amounts to make soups and pan cakes, as well as a spice and flavoring agent. It works well as a stomach stimulant and against anorexia in India's traditional medical system[10].You can eat fenugreek seeds raw or cooked. They are aromatic, bitter, carminative, galactogogue, and antimicrobial. 50% of the seed is made up of inaccessible carbohydrates[11].Fenugreek seed has several therapeutic uses, including anticancer, hypocholesterolemia, lactation support,

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antimicrobial, stomach stimulant, anorexia treatment, antidiabetic agent, and galactogogue. Fenugreek's physiological benefits, such as its antidiabetic and hypocholesterolemic properties, are mostly attributed to its intrinsic dietary fiber content, which has shown promise as a nutraceutical[12].Each 100 grams (g) of fenugreek seeds comprises 60% carbohydrates, 25% dietary fiber, 23 g protein, 6 g lipids, and 9 g water. Fenugreek is particularly rich in potassium, phosphorus, magnesium, and calcium. Fresh fenugreek leaves contain about 86% water, 6% carbohydrates, 4% protein, and about 1% each of fiber and fat[13].Fenugreek seeds, which are available whole or ground, have a pleasant bitterness and subtle sweetness that is used to flavor a variety of meals, such as curry powders, spice blends, and teas. The seed has a core, hard, yellow embryo surrounded by a horny, comparatively large coating of white, semi-transparent endosperm [14].The firm seeds of fenugreek are brownish-yellow when grown up. They have a a unique, fragrant scent and are employed in cooking, food items, alcoholic beverages, and non-alcoholic drinks [15].



Fig no.1- Fenugreek seeds

Nutracutical Properties

a)Anticancer Effect

One of the major causes of death worldwide is cancer. Numerous published research employing cell lines or experimental animals have demonstrated the preventive effect of fenugreek seeds in cancer models[16].Fenugreek contains a bioactive compound, 'diosgenin,' which is an anti-cancer agent.Thymoquinone and diosgenin have anti-neoplastic properties because they inhibit Akt and JNK phosphorylations, promote the expression of apoptotic genes and caspase activity, and stop cell division. These two bioactive substances have anti-proliferative qualities as well as synergistic effects[17].The cytotoxic quality of fenugreek has been demonstrated to be helpful in the management and prevention of cancer[18].When rats were given 1,2-dimethylhydrazine, a diet containing fenugreek seed powder reduced the incidence of colon tumors and hepatic lipid peroxidation. It also enhanced the activities of catalase, superoxide dismutase, glutathione S-transferase, and glutathione peroxidase in the liver[19].

b)Antibacterial and Antifungal Effect

Fenugreek is a valuable source of physiologically active compounds that can be used to create more effective and innovative antifungal medications.Multiple studies have reported the efficacy of fenugreek extracts against Helicobacter pylori.According to a study, fenugreek pollens are more abundant in honey samples with the most antibacterial action against Staphylococcus aureus, Pseudomonas aeruginosa, and Escherichia coli than in flowers.The fenugreek can be used in the treatment of patients with calcic urolithiasis[5].Among other herbal extracts, fenugreek's antibacterial potential has gained popularity. Studies have been conducted on the efficacy of fenugreek against various microorganisms.Bioactive substances found in fenugreek leaves include glycosides, ascorbic acid, phenolic compounds, and flavonoids such as quercetin, vitexin, and kaempferol. These flavonoids also function as a bioactive source or reducing agent for the creation of silver nanoparticles[3].

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C)Gastroprotective Effects

Gastric ulcer treatment is one of the traditional uses of fenugreek. On rats with ethanol-induced stomach ulcers, the ulcer-preventive potential of fenugreek seeds was investigated in comparison to omeprazole.The presence of flavanoids in fenugreek may be responsible for its antiulcer properties, as they have been shown to shield the mucosa from the development of ulcerative lesions caused by a variety of necrotic agents[7]. Unhealthy eating habits and lifestyle choices cause peptic ulcers, gastric ulcers, nausea, vomiting, and discomfort in the abdomen. Numerous research have demonstrated fenugreek's protective properties against gastrointestinal disorders. It has anti-inflammatory, anti-ulcer, gastroprotective, antioxidant, and anti-secretory qualities[3].

d) Antidiabetic Effect

It has been observed that fenugreek's bioactive ingredients, such as galactomannan, saponins, trigonella, diosgenin, and 4-hydroxy-isoleucine, have beneficial benefits on diabetes. Numerous distinct components have been identified. Research has shown how they affect blood sugar[3].By restoring pancreatic B-cell function and blocking, among other many physiological mechanisms, fenugreek regulates diabetes. activity of alpha-amylase and sucrase. 4- Pancreatic B-cells secrete insulin in response to hydroxyisoleucine. The fenugreek saponin extract has demonstrated hepatoprotective, hypolipidemic, and anti-diabetic properties[20].The high fiber content found in fenugreek powder or seeds could also be beneficial for supporting blood sugar control, even in people without diabetes[21].

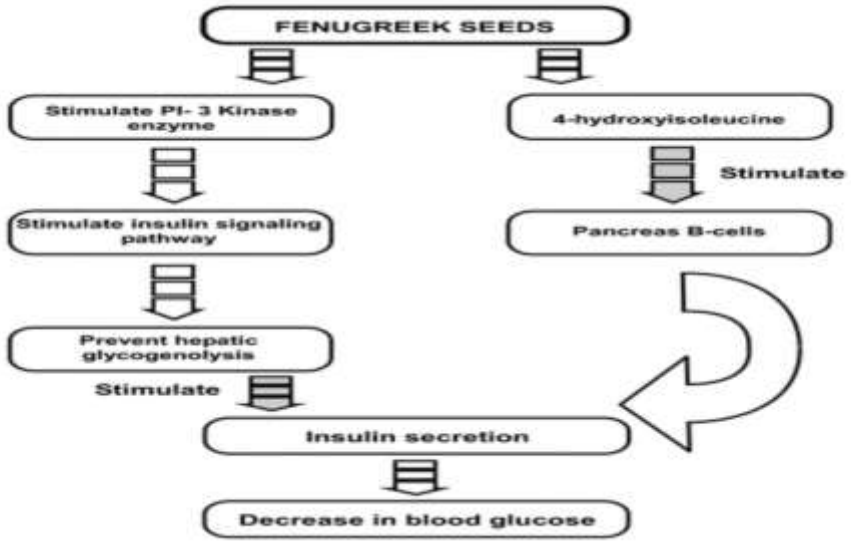


Fig no : 2 (Mechanism of action of Fenugreek in diabetes)

e) Antioxidant Effect

Nowadays, it is believed that oxidative damage at the cellular or subcellular level plays a significant role in the development of diseases such as diabetes, cancer, inflammatory diseases, coronary vascular disease, and aging. Both the mitochondria and the genetic material of cells are harmed by reactive oxygen radicals. They cause significant membrane damage and membrane-mediated chromosomal damage by inducing lipid peroxidation in cellular membranes[22]. 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[23].

f) Other Properties of Fenugreek

Fenugreek leaves and seeds were recommended due to their haematinic properties. High levels of iron have reportedly been found in the seeds, and fenugreek germination increases the amount of vitamins A, B, and C in the plant. Rich in vital amino acids, ascorbate, and folate, they provide restorative and nutritional qualities and have been shown to increase hemoglobin levels in the blood[24].Fenugreek has also been used to shield the liver from hepatotoxicity caused by ethanol[25].Additionally, fenugreek has been shown to be an effective adjuvant treatment for Parkinson's disease patients when used in conjunction with L-Dopa [26].In other investigations, fenugreek seed extract shown analgesic benefits, possibly through reducing inflammation[27].

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g) feenugreek Seeds for Hairs

Methi seeds work wonders to reverse baldness and hair thinning, as well as to combat dandruff and hair loss. Nicotinic acid and proteins included in fenugreek seeds, also known as methi, are excellent for hair development. Large quantities of lecithin, which moisturizes and strengthens hair, are present in it. It heals a range of scalp disorders, cures dandruff, conditions hair, keeps the scalp cool, and lessens dryness in the hair. It gives strength from the roots and is very helpful against hair loss. Methi's lecithin aids in repairing and regrowing dry, damaged hair. The natural tonic aids in hydrating hair and restoring its shine and bouncy texture. A common condition affecting hair, dandruff appears especially[28].It works well for treating dermatitis and dry scalps as well. The emulsifying agent lecithin is found in fenugreek seeds. The seeds release a slick material that gives hair a glossy appearance when soaked in water. Methi seeds are the best option for conditioning hair because of this feature. Fenugreek mucilage mimics that slick appearance. Reversing baldness is one of fenugreek's most well-liked hair applications. Hormone precursors found in fenugreek promote hair development and aid in fortifying and regenerating hair follicles[29].

h) Controlling Rheumatoid Arthritis

Rheumatoid arthritis is a joint condition characterized by tissue damage and synovial growth, resulting in persistent inflammation. A significant contributor to increased joint discomfort and pain is elevated energy expenditure as well as pro-inflammatory cytokines like interleukin (IL-6) and tumour necrosis factor-alpha (TNF-α)[30].As an autoimmune disease, rheumatoid arthritis has been linked to estrogen-like substances that have been shown to reduce tissue inflammation by binding to DNA and initiating pathways that mitigate the effects of autoimmune diseases[31].



Utilization of Fenugreek in Various Food Products

a) Fenugreek as food stabilizer, Food Adhesive, Food Emulsifier And Gum

The ability of the fenugreek protein to stabilize and emulsify the dietary ingredients depends on how it interacts with them.Due to its galactomannan composition, fenugreek's dietary fiber has the potential to be widely used in the food sector for its emulsifying and stabilizing qualities.Dietary fiber from fenugreek has been utilized to make baked items like cakes, bread, pizza, and muffins. The addition of fenugreek to flour enables the creation of nutritious meals that might be well-liked by people following western diets.

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b)Fenugreek in Bakery Products

A good source of dietary fiber and numerous essential minerals is the husk of fenugreek seeds. You may make high-fiber muffins using this fiber-rich functional ingredient.The bread retained the beneficial effect of fenugreek, which lowers insulin resistance. Consequently, this study clearly shows that fenugreek can be used in baked goods up to a reasonable amount, which can help treat diabetic patients and lower insulin resistance.Biscuits made with up to 10% fenugreek flour have been produced without sacrificing their overall quality. Overall, the most favorable composite fenugreek flour biscuits were those with 10% germinated fenugreek flour based on their physical, sensory, and nutritional qualities.The research verified that fenugreek seed—raw, soaking, and germinated—substantially decreased serum total cholesterol, LDL cholesterol, and total lipids; however, triglycerides and serum HDL cholesterol did not change significantly.Fenugreek leaves, seeds (both dry and germinated), and wheat flour added with 5-10% of the grain's dry and germinated fenugreek powder enhanced the amount of total proteins, fibers, iron, zinc, calcium, vitamin B, carotene, vitamin E, and vitamin C in basal diets. These dietary supplements have nutritional and restorative qualities since they also help anemic rats' blood image. It is safe and healthful to use fenugreek products as dietary supplements on a daily basis.

c)Fenugreek in Traditional Food

A common dish in Turkey is fenugreek paste, also known as "Cemen," which is made from mashed fenugreek seeds. The balls used to produce clarified butter are made from crushed fenugreek seed or coarse fenugreek powder[12].

d) Fenugreek gum as a stabilizer in Ice Cream

To determine the effects of various fenugreek gum concentrations as an ice cream stabilizer, a research named "Utilization and evaluation of fenugreek (Trigonella foenum graecum) gum as a stabilizer in ice cream" was conducted. After the mucilage from fenugreek (HM-57) seeds was removed, 20% of the gum could be produced. The gum was evaluated for its acceptability as a stabilizing agent in ice cream. Gum was incorporated into the ice cream at concentrations of 0.5%, 1.0%, 1.5%, and 2.0% before its physical and sensory qualities were evaluated.Furthermore, it was discovered that as fenugreek gum was added in greater amounts, the overrun and melting characteristics of the ice cream improved. Fenugreek gum is a good natural stabilizer that can be added to diabetic products. It has been demonstrated to be effective in ice cream[32].

CONCLUSION

This review discusses the benefits of fenugreek, including its anti-diabetic, anti-cancer, Antibacterial and antifungal, Gastroprotective effect, Antioxidant, controlling rhematoid arthritis, for hair, other properties of Fenugreek. Significant bioactive substances have been discovered in fenugreek.also discuss the Utilisation of Fenugreek seeds in various food products.This review revealed that fenugreek has been utilized as a gum, food emulsifier, food stabilizer, and food glue. Several kinds of baked goods and extruded products have been made with fenugreek. Given the numerous health benefits that have been reviewed in this article and the numerous previously published scientific studies supporting them, fenugreek is safe to use liberally and offers a host of health advantages. As such, it is suggested that we incorporate it into our daily diet.

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