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Review Article

Trigonella Foenum-Graecum (Fenugreek) on Antidiabetic Effect

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ABSTRACT

One of the most prevalent endocrine metabolic diseases is diabetes mellitus. The traditional antidiabetic treatment is having more and more side effects. Fenugreek is one of many herbs that have potent antidiabetic effects. Despite being one of the most often used herbs for diabetes, little is known about fenugreek's ability to lower blood sugar levels. Reporting fenugreek's evidence-based antidiabetic properties was the goal of this review. Using the keywords "trigonella foenum graecum for the control of diabetes," we conducted a PubMed/Medline search to examine pertinent English-language publications. 18 of the 26 articles that were located were included in this review. Drawing from existing research, this review posits that fenugreek possesses evidence-based antidiabetic properties, including the ability to stimulate and/or regenerate B cells in addition to its extrapancreatic activity, which effectively lowers blood glucose levels in diabetic individuals.

INTRODUCTION

Background

One of the most prevalent endocrine metabolic diseases, diabetes mellitus (DM), is typified by hyperglycemia and is brought on by deficiencies in either insulin action or secretion, or both. [1] The International Diabetes Federation estimates that 366 million people had diabetes in 2011, and that the disease causes roughly 4.6 million deaths annually.[2] The World Health Organization estimates that by 2030, there will be 79.4 million people with diabetes mellitus in India, up from 31.7 million in 2000. Patients on antidiabetic medication therapy have experienced a variety of adverse effects, including lactic acid toxicity, hypoglycemia, and gastrointestinal distress.[4] Fenugreek is one of the many herbs that have potent antidiabetic qualities. [1] Despite being one of the most often used herbs for diabetes, little is known about fenugreek's ability to lower blood sugar. Therefore, the purpose of this review was to present the fenugreek's evidence-based antidiabetic properties.

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MATERIALS AND METHODS

In order to assess the relevant English-language literature, we conducted a PubMed/Medline electronic database search using the keywords "Trigonella foenum graecum for the management of diabetes." This review included every pertinent article that met the inclusion and exclusion criteria listed below. The following are requirements for inclusion criteria: clinical trials, controlled trials, randomized controlled trials, systematic reviews, and meta- analyses involving fenugreek either by itself or in conjunction with other herbs. Exclusion criteria include research methods, comments, and papers lacking full text or abstracts, as well as articles with similar or no information. In this review, numerous papers were reported.

Fenugreek And Methods of Its Application

Fenugreek (Trigonella foenum-graecum)

The seeds of the Fabaceae family, which is widely distributed throughout India, are commonly used as an ingredient in spices [4] because of their antidiabetic, antihyperlipidemic, and antioxidant qualities.[5] Its medicinal potential is due to its constituents, which include saponins, diosgenin, trigonelline, alkaloid high fiber, 4hydroxyleucine, and 4- hydroxyisoleucine [1, 3].

□ Effects of fenugreek

Anti-diabetic, antihyperlipidemic, [5,10], b-cell-stimulating/regenerating, [11], antilithogenic potential, [4], antioxidant, [3,5], and neuroprotective properties are all attributed to fenugreek.[12] Studies on fenugreek's effects in diabetes mellitus using a range of techniques and dosages, One of the natural supplements that has been shown to lower risk, enhance glycemic control, and lessen the requirement for insulin therapy in people with diabetes mellitus is fenugreek.[13]

(1) Plasma glucose levels were regulated by taking 500 mg of fenugreek once or twice a day, either by alone or in conjunction with synthetic antidiabetic medications like glipizide and metformin.

(2) A 15-g water-soaked fenugreek seed supplement dramatically lowered postprandial blood sugar (PPBS) levels.

(3) The glucose tolerance test was improved and fasting blood sugar (FBS) was considerably decreased by dietary supplementation of 25 and 100g of fenugreek seed powder daily for 15 and 10 days, respectively.

(4) FBS and PPBS were significantly reduced by taking a 1-gram powder that contained an equal amount of raw fenugreek seed, bitter gourd, and jamun seed powder in the form of capsules and salty biscuits every day for 1.5 months, followed by a 2-gram powder for another 1.5 months.[7]

(5) It has been demonstrated that giving diabetic rats oral diosgenin, an active ingredient in fenugreek, at varying doses (15, 30, and 60 mg/kg body weight) every day for 45 days significantly lowers blood glucose levels, raises plasma insulin levels, and significantly restores the altered activities of key enzymes involved in the metabolism of carbohydrates in the diabetic rats' kidneys and muscles to levels that are close to normal. Furthermore, these outcomes were similar to those of Glibenclamide, a common oral medication for hypoglycemia.[6]

(6) It has been demonstrated that fenugreek seed hydroalcoholic extract at 500, 1000, and 2000 mg/kg increased body weight and glucose uptake, decreased plasma glucose, glycosylated hemoglobin (HbA1c), liver glucose transport,

proinflammatory cytokines, pancreatic enzymes, and significantly and dose-dependently restored depleted muscle and liver glycogen and total protein. Additionally, it has been demonstrated to restore glutathione and superoxide dismutase (liver and pancreas) and prevent lipid peroxidation. Furthermore, in alloxan-induced diabetic rats, there was a noticeable improvement in the histoarchitecture of the liver and pancreas.[9]

- **Fenugreek's effects when combined with yogurt and hot water**

Unlike the fenugreek seeds combined with yoghurt, 10-g of fenugreek seed powder in hot water every day for eight weeks dramatically reduced the FBS, triglycerides, and very low - density lipoprotein (VLDL) cholesterol. [7 and 14]

- **Sulfonylureas and Fenugreek**

It has been demonstrated that taking 18 fenugreek pills daily in addition to oral sulfonylureas can dramatically lower FBS, PPBS, and HbA1c levels as well as the related clinical symptoms in patients with uncontrolled type-2 diabetes. It implies that fenugreek supplementation combined with sulfonylureas was a successful treatment for diabetic individuals whose blood glucose levels were out of control.[7]

Glimepiride-containing hydroalcoholic fenugreek seed extract: It has been shown to enhance Glimepiride's hypoglycaemic effects.[9]

1. Fenugreek's Antidiabetic Impacts and Possible Mechanisms

According to reports, fenugreek seed extracts have antidiabetic potentials by delaying the rate of glucose absorption and gastric emptying; decreasing the small intestine's uptake of glucose due to its high fibre content, which lowers blood glucose and slows the metabolism of carbohydrates; and reestablishing the function of pancreatic tissues.[2,5] preserving b cells; increasing serum insulin levels, perhaps by b-cell regeneration or by inducing insulin release from islet b cells that are already present; boosting glycogen synthetase activity and encouraging the production of muscle and liver glycogen; [1] lowering proinflammatory cytokines and pancreatic enzymes and encouraging the replenishment of depleted muscle and liver glycogen;[9] altering the activity of insulin-sensitive enzymes involved in the metabolism of carbohydrates; adjusting serum lipid profiles;[1] boosting insulin sensitivity, enhancing insulin action at the cellular level, preventing lipid peroxidation, and restoring glutathione and superoxide dismutase (liver and pancreas); [9], and lowering the HbA1c level by using glucose in peripheral tissues to maintain blood glucose levels.[1] Numerous investigations have documented the part free radicals play in the pathophysiology of diabetes mellitus, where oxidative stress and a decline in antioxidant status coexist.[4] Antioxidant activity in fenugreek has been demonstrated [2,5], which may help stop the development of diabetes. According to a prior study, Rhizopus oligosporus' solid-state bioconversion of the fenugreek substrate dramatically raises the natural a-amylase inhibitors linked to high phenolic antioxidants, which may lower the glycemic index and is therefore thought to be helpful in the treatment of disorders related to carbohydrate metabolism linked to diabetes mellitus.[15] In rats, mice, and humans, isolated islet cells have been shown to produce more insulin in response to glucose stimulation when fenugreek seed contains hydroxyleucine, a new amino acid. Four-hydroxyisoleucine, which makes about 80% of the free amino acid in fenugreek seeds, has been

shown to have insulin-stimulating qualities [30] and improve peripheral tissues' insulin sensitivity and glucose uptake.[2]. In a mouse model, 4-hydroxyisoleucine has been shown to slow the development of type-2 diabetes.[4]. According to a different study, fenugreek oil stimulates insulin and the immune system in all rats, which results in an antidiabetic effect.[4] In diabetic rats, daily oral administration of fenugreek steroids has been demonstrated to significantly lower blood glucose levels, significantly improve the area of insulin-immunoreactive B cells, significantly reduce abnormalities in sperm shape, and improve sperm counts.[4]

The function of fenugreek in the etiology and complications of diabetes mellitus

A disorder with abnormal fat and carbohydrate metabolism is indicated by diabetes mellitus.[4] In STZ-induced diabetic rats, key enzymes involved in the metabolism of carbohydrates, including hexokinase, glucose-6-phosphatase, and glucose-6phosphate dehydrogenase, were changed. However, it has been demonstrated that aqueous extract of T. foenumgraecum L. and Psoralea corylifolia seeds in a composite manner (1:1) significantly recovers the activity of these enzymes in hepatic tissue [1], which is why it is said to rectify the aberrant metabolism. Diabetes is frequently linked to atherosclerosis, hypertension, and hyperlipidemia.[4] According to one study, a fenugreek diet significantly lowers serum total cholesterol, low - density lipoprotein (LDL) cholesterol, VLDLcholesterol, and triglycerides. It also significantly lowers FBS, 24-hour urinary glucose excretion, and improves the glucose tolerance test.[16] A polyherbal formulation comprising T. foenum-graecum, Allium sativum, Aloe vera, Nigella sativa, Plantago psyllium, and Silybum marianum has been demonstrated in another study to be safe and effective in reducing TbA1c, FBS, triglycerides, and LDL cholesterol levels in patients with advanced stage type-2 diabetes.[17] It implies that because of its impact on cholesterol metabolism, fenugreek may have hypolipidemic and antilithogenic properties. This will lessen the chance of atherosclerosis, hypertension, and hyperlipidemia developing.[4] Numerous studies have documented the function of free radicals in the pathogenesis of diabetes and its complications, despite the fact that the pathophysiology of the disease is not fully understood.[4] Antioxidants help prevent and treat oxidative stress, which may be a significant factor in the development and progression of diabetic vascular problems.[5] According to reports, fenugreek possesses antioxidant activity [2,5], and its substrates have been demonstrated to dramatically raise phenolic antioxidants [15], which may help avoid the pathophysiology of diabetes and associated effects. According to reports, reactive oxygen species (ROS) are produced in several diabetic tissues and contribute to the development of insulin resistance and pancreatic b-cell dysfunction.[4] Fenugreek seed contains the amino acid 4-hydroxyisoleucine, which has been shown to improve insulin sensitivity and stimulate/regenerate pancreatic b cells [11]. This may help avoid insulin resistance and ROS-induced pancreatic b-cell malfunction. Tissues that are dependent on insulin and the liver are essential for maintaining lipid and glucose homeostasis. During diabetes, these are significantly impacted.[2] Fenugreek has been shown in one research to reduce hyperlipidemia and hepatic steatosis by inhibiting the expression of lipogenic genes' messenger ribonucleic acid (mRNA). Fenugreek's active ingredient, diosgenin, has been shown to inhibit fat formation in HepG2 cells by acting as an antagonist on the liverX-receptor. It therefore contributes significantly to the therapeutic impact of fenugreek on abnormalities of lipid metabolism in

the liver of obese diabetic KK-Ay mice.[10] Its seed powder has been demonstrated in other trials to restore normal creatinine kinase activity in the heart, skeletal muscles, and liver. It has been observed that fenugreek oil consumption significantly lowers renal toxicity and improves the hematological state of alloxanized rats.[3, 4] It has been demonstrated that diabetes considerably increases certain intestinal disaccharidase activity. These actions suggest that fenugreek seed mucilage has a positive function in managing diabetes and its complications, even though it has been shown to improve the condition.[8] Neuropathy and diabetic retinopathy are frequent side effects of diabetes mellitus. According to a study, fenugreek seed, either by alone or in conjunction with sodium orthovandate, can effectively prevent retinopathy and other issues associated with diabetes.[4] According to a different study, fenugreek seed powder has neuroprotective properties that likely work by reducing oxidative stress and hyperglycemia, which helps manage and prevent diabetic problems.[12]

5. Fenugreek's Role in Type-1 DM

There are two types of insulin-dependent diabetes (IDDM): idiopathic diabetes and autoimmune (immune-mediated) diabetes.[4] Consuming 100g of defatted fenugreek seed powder at lunch and dinner has been demonstrated to enhance the glucose tolerance test and dramatically lower serum total cholesterol, FBS, triglycerides, LDL, and VLDL cholesterol in patients with IDDM. There was no change in the high-density lipoprotein (HDL) cholesterol component.[16] Since IDDM is characterized by b-cell death and causes significant harm to the pancreatic b cells, this improvement in IDDM may be achieved by increasing the serum insulin level, b-cell regeneration, and/or enhanced pancreatic insulin from existing islet b cells [1].[4]

6. Additional considerations for the use of fenugreek in DM

Better substitutes are offered by medicinal plants like fenugreek, which are typically less poisonous, more reasonably priced, non-toxic, and have a broad safety margin.[4] Fenugreek has been shown to have antidiabetic potential in experiments and there is strong scientific evidence (Level B2) that it helps diabetic people lower their blood glucose levels [7].[18]

7. CONCLUSION

This review's analysis of the literature indicates that fenugreek has evidence-based antidiabetic effects, including the ability to stimulate and/or regenerate b-cells and have additional pancreatic actions that effectively lower blood glucose levels in diabetic individuals.

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