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REVIEW ARTICLE

Nutraceutical Intervention of *Methi* (*Trigonella foenum-graecum*) in the Management of *Prameha* (Diabetes Mellitus): A Critical Review

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ABSTRACT

Diabetes mellitus closely resembles the ayurvedic disease process of prameha and it has turned into a chronic disorder of metabolism that needs safe and complementary treatment measures besides the administration of conventional drugs. It was a critical review of scientific evidence existing on the use of methi or fenugreek (*Trigonella foenum-graecum*) as a nutraceutical supplement in the management of the many facets of prameha. The three main bioactive components of fenugreek are the main mechanism of its action. All these bioactive components act separately to resolve the central pathophysiological problems of type 2 diabetes mellitus. First, galactomannan is a water-soluble dietary fiber that is capable of prolonging the time taken by the stomach to empty and flatten the post prandial glucose (ppg) response curve. Second, 4-hydroxyisoleucine (4-oi) is an uncommon non-proteinic amino acid mostly found in the fenugreek seeds and functions an insulin secretagogue that enhances periphery insulin sensitivity. Lastly, there is a lipid lowering effect or medohara of fenugreek caused by steroidal saponins and trigonelline. The clinical trials have consistently shown improvements in glycemic control with the daily supplementation of 10g to 25g of ground fenugreek seeds by lowering the levels of fasting plasma glucose and also by a small but statistically significant decrease of glycated hemoglobin (HbA1C) (0.5 percent to 1 percent after 8 to 12 weeks). Although, clinical trials have demonstrated that this supplementation also led to considerable decreases in total levels of cholesterol and triglycerides that

reduced diabetic dyslipidemia. In general, as the most prevalent side effects are mild gastrointestinal disorders, which are not harmful but may be common with many other medications, methi offers a scientifically justified, cost-efficient, and safe way of helping in the long-term management of prameha. Further studies are to be done to create and study extracts of methi that are standardized to the degree of active components (in this case 4-oi), to offer some kind of uniformity in efficacy.

Keywords: Fenugreek (*Trigonella foenum-graecum*), *Prameha* (Diabetes Mellitus),4-Hydroxyisoleucine (4-OH Ile), Glycemic Control, Dyslipidemia (Lipid Profile/*Medohara*), Nutraceutical.

INTRODUCTION

Background of *prameha* and diabetes mellitus

Diabetes mellitus (DM) is a persistent metabolic disease that is marked by a constant increase in blood glucose levels caused by deficiencies in the insulin secretion, insulin action, or both, is a universal epidemic. This is similar to the Ayurveda system of medicine in ancient Indian tradition and is known as *Prameha*, which is a condition characterized by *Kleda* (excess moisture/fluidity) and Mutra Vriddhi (polyuria). The most severe type is expected to be *Madhumeha* (literally 'honey urine'), and it directly relates to DM. The existing pharmacological treatment, although effective, usually bears risks of adverse effects and cannot cover all the metabolic derangements, which requires the development of effective, low-cost, and safe complementary interventions[1].

Methi as a traditional remedy

Methi (Fenugreek, *Trigonella foenum-graecum*) is a herb that is used as spice and traditional medicine widely in South Asia and Middle East annually. Both Ayurvedic and Unani medicine have traditionally suggested it as an Ayurvedic *Madhumehahara* (anti diabetic) and *Medohara*(lipid lowering/anti-obesity) agent[2]. It is a good candidate of a nutraceutical intervention in the treatment of *Prameha* due to its easy accessibility, affordability, and effective safety profile.Dyspnoia Fenugreek seeds are pebbly hard, compact, rhomboidal bodies that are about 3-5mm long and about 2mm thick. They are normally light brown to yellow in color. The seeds have a characteristic distinctive smell of spicy aroma and bitter, mucilaginous taste. Fenugreek seeds are nutritionally balanced with carbohydrates of about 45-60 percent with almost a third of it being soluble fiber and the rest insoluble fiber. They are also 20-30 percent protein, but contain essential amino acids like lysine and tryptophan, but contain volatile oils in small amounts. [3,4,5]

Fenugreek nutritional value per 100 g - (Table 1)

Percent daily value of selected nutrients-(Table 2)

REVIEW OBJECTIVE

The present review critically analyzes and synthesizes the available scientific data on *Methi*(*Trigonella foenum-graecum*), especially in relation to its bioactive constituents, mechanism of action and clinical efficacy. This is aimed at investigating its feasibility as a nutraceutical intervention towards improving glycemic control and lipid parameters in the subjects of *Prameha*(Type 2 Diabetes Mellitus).

METHODS

Search strategy and data sources

The literature search has been carried out in big electronic databases, such as PubMed, Cochrane, Science Direct, and Google Scholar. The following major keywords and combinations were used to conduct the search: "Fenugreek," "Methi," "*Trigonella foenum-graecum*," "Diabetes Mellitus," "*Prameha*," "Nutraceutical," "Hypoglycemic," and "Anti-

diabetic." The articles that were included in the search were published mostly in the period of 2000-24 so that the current clinical information could be considered.

Selection criteria

Inclusion criteria for the review were

1. Original research articles and systematic reviews/meta-analyses that are concerned with the effect of Fenugreek (seeds, powder or extract) in human subjects (adults) with DM or pre-diabetes (analogous to Prameha).
2. Studies reporting clinical outcomes related to glycemic indices (FPG, PPG, HBA1C or lipid profile (TC, TG, HDL-C, LDL-C).
3. Articles published in the English language.

The literature on other combinations of herbs, animal models alone, or lacking quantifiable clinical evidence were excused.

Data synthesis and analysis

The qualitative synthesis and critical analysis of the data on the chosen articles were conducted. The review aimed at extracting homogenous results about dose-response relationship, the key bioactive molecules that are involved and their affirmed mechanisms of action to provide scientifically reasonable basis of nutraceutical role of *Methi* in *Prameha* management.

RESULTS

Bioactive Components and Mechanisms of Action

Fenugreek's therapeutic efficacy is attributed to a synergistic combination of unique chemical constituents[6]:

Soluble Dietary Fiber

The soluble dietary fibre (SDF), predominantly Galactomannan one of the types of heteropolysaccharides which constitute almost half of the seed dry weight is also abundant in the seeds. The fiber creates a viscous material in the GI tract which slows the gastric emptying and acts as a physical barrier to the fast uptake of glucose, hence flattening the PPG curve[7].

4-Hydroxyisoleucine (4-OH Ile)

The uncommon amino acid, 4-OHIle, is believed to be the most active antidiabetic principle. It works primarily by incretion of the pancreatic b-cells for glucose-dependent insulin release [8]. It also has been demonstrated to increase insulin sensitive in peripheral tissues, which directly targets the underlying pathophysiology of Type 2 DM (Insulin Resistance in Prameha).

Saponins and alkaloids

Saponins are steroidal (e.g., diosgenin) and alkaloid (e.g., Trigonelline) and both create hypoglycemic and hypolipidemic effects. Trigonelline was also found to stimulate the control of enzymes that participate in glucose metabolism in the cells and the saponins also disrupt the absorption of cholesterol, which helps in controlling the condition of diabetic dyslipidemia[9].

Clinical efficacy on glycemic control: (Table 3)

A study involving 10g/dayof Fenugreek seed powder in T2DM patients noted a significant drop in FPG and HBA1C after 6 months[10] Another long-term study (3 years) in pre-diabetic subjects showed that 10 g/day of Fenugreek powder significantly reduced the cumulative incidence of developing Type 2 DM, highlighting its preventative potential in *Prameha*[12].

Clinical efficacy on lipid profile

Methi has also been shown to have the *Medohara* (lipid-lowering) effect which has been clinically supported, and has been shown to be found in meta-analyses as a treatment in the management of diabetic dyslipidemia, a significant precipitating factor in the development of macrovascular complications in Prameha:

TG and TC: A decrease in mean TG (14%) and in mean total cholesterol 21% with 10 g/day, was reported among the different trials.

HDL-C: Although there is also a trend for LDL-C reduction, some significantly have an HDL-C increase, which elevates the atherogenic index counteraction [11].

DISCUSSION

Methi as a multi-modal nutraceutical in prameha

This present review has positive results that can help in substantiating the traditional claim of *Methi*(*Trigonella foenum-graecum*) in the treatment of *Prameha*. *Prameha* has been described according to Ayurveda as the systemic metabolic disorder with vitiated *Kapha dosha*, deranged *Meda dhatu*, deposited *kleda* (due to the excesses of the nutrients), impaired Agni and *Srotorodh*. Its stage, *Madhumeha*, is a similar stage to Type 2 Diabetes Mellitus (T2DM). *Methi* introduces a Holistic Window of Medicinal profile of Lens in conformity to the classical Ayurveda Aspects and as an extent to bio-medical Aspects. Fenugreek as an amalgamate nutraceutical should be considered in the context of multi-modality of multiple pathophysiological mediators that are involved in the course of T2DM/*Prameha*[6]. Unlike single-target drugs, it also controls glucose absorption, insulin secretion, insulin receptor and lipid metabolism simultaneously. Such general metabolic normalisation is analogous to the idea of restoration of balance in the body as opposed to Ayurveda which aims to put specific symptoms into remission. The water-soluble portion of dietary fiber especially galactomannan plays a significant physiologic role in glycemia regulation. On ingestion, it solidifies in the stomach due to the type of composition that prevents emptying of the stomach and decelerates the uptake of carbohydrates. This also adds significant flattening of the postprandial glucose curve [7]. According to Ayurveda, this exercise would be linked to stabilization of deranged *Jatharagni*, and inhibition of production of Ama (a final cause of metabolic impediment, *Srotorodha*). The effects of dampening sharp glycemic fluctuations and reducing the stress on the functionality of pancreatic beta cells in the metabolic defense of fenugreek are attributable. The other major bioactive is 4-hydroxyisoleucine that has glucose-dependent insulinotropic activity.

It triggers the release of insulin glucose-dependently to minimize the chances of hypoglycemia occurrence [8]. It also increases the peripheral insulin sensitivity the major malfunction of insulin resistance in T2DM [8]. Ayurvedic theorizing It can be postulated in Ayurvedic terms, that *Dhatvagni* can be associated with the correction of the malfunction at *Dhatvagni* level, particularly of Meda dhatu, and remedy of the pathology of the disease by *Kapha-Meda vriddhi*. Fenugreek has curative effects at various metabolic levels because of its action on the kinetics of insulin and insulin tissue sensitivity. This therapeutic value is also enhanced by the presence of hypolipidemic properties of fenugreek. Steroidal saponins and triglycerides decrease serum total cholesterol and triglycerides [6]. The outcomes of clinical trials and meta-analysis indicate improved lipids especially total cholesterol (TC) and triglyceride level (TG), especially with a 10-25 g/day supplementation [11,13]. Because dyslipidemia is among the major causes of macrovascular complications in diabetes, this *Medohara* effect appears to be a significant preventive activity. The improvement in lipid profile may be attributed to normalization of aggravated *meda dhatu* and obstruction of *srotas* resulting to reduction of the risk of cardiovascular disorders in the future. There is clinical support of the enhancement of glycemic indices by the use of fenugreek supplements. Fasting plasma glucose (FPG) and postprandial glucose (PPG) reductions have been reported and a moderate yet clinically significant reduction in HbA1c (0.5-1.0% over 8-12 weeks) has been reported [10,13]. The dosage range of 10-25 g per day of powdered seed or the equivalent health-wise in extract is said to be very successful [10,13]. These results provide strong evidence to support its use as an addon in the management of chronic glycemia.

Integrative relevance and long-term applicability

It is also safe to consume over extended periods, and this is one of the other reasons why fenugreek is so great. Daily dietary intake of it does not require much lifestyle change as, as a dietary everyday spice, it is regularly consumed. This has been found to enhance patient compliance as compared to the use of chemicals. Even after cooking it has been reported that there are traces of its hypoglycemic effect and it can be consumed as a food [2]. Fenugreek should be viewed as complementary to conventional therapy rather than alternative therapy according to the integrative medicine perspective. Due to its multi-targeted metabolic action, it will potentially work synergistically with the oral hypoglycemic agonists (OHAs) and provide superior glycemic control without having to use an increased pharmacological dose. With this fact, however, it is not surprising at all when we realize that the management of Prameha according to Ayurveda requires simultaneous approach towards Ahara and Vihara as well as towards Aushadha. It is also an impressive aspect that it can be used preventively. A prediabetic long-term intervention trial observed that the overt T2DM development was reduced significantly by the daily treatment of fenugreek [12]. It shows one has a role as an early metabolic correcting agent, like in the case of persons of *Kapha-pradhana Prameha*. Earlier intervention of the individuals experiencing compromised glucose tolerance can delay the onset of the disease and reduce its effects. Safety plays an important role in the management of chronic diseases. Fenugreek is described to be safe in all the available clinical literature where the adverse effect is mostly of mild gastrointestinal symptoms such as bloating and flatulence [13]. Such effects tend to be self-limiting and of its fiber content. Most importantly, human trials fail to identify any clinically significant organs toxicity manifestations that would prove its safety as a long-term usage.

LIMITATIONS AND FUTURE DIRECTIONS

Even though there is positive news on the variable phytochemical composition, it is also a demerit. Seed cultivar, geographical origin and processing techniques have a varied potential to affect the contents of bioactive molecules in particular, 4-hydroxyisoleucine [8]. The variability in this case has the potential to affect the uniformity of the treatment. Although extracts have been utilized in the 200 studies and clinical trials reported, future investigations should tend towards standardization of the extracts that determine the important bioactive factors. Prolonged, multicentric RCTs involving long-term follow-up are needed to investigate the long-term cardiovascular and microvascular advantages. Further protection effects in diabetic complications may be explained by more mechanistic studies on the basis of anti-inflammatory and antioxidant pathways. The synergistic effects of fenugreek with other *Pramehaghna dravyas* or in the combination with structured lifestyle modifications should be researched to achieve the better results. These multi-ingredient methods have been aligned with Ayurvedic standards of classical methods of managing diseases. To sum up, *Methi* (*Trigonella foenum-graecum*) is a scientifically supported multidiabetes nutraceutical intervention plan of *Prameha*. It possesses a multitarget effect with the capacity to regulate glucose absorption, improve insulin intake and sensitivity and improve lipid parameters thereby treating multiple elements of metabolic derangement [6,10,13]. Fenugreek is potentially a safe, inexpensive, and effective adjuvant or addition to the overall diabetes treatment programme with proper normalizing and rigorous clinical testing.

CONCLUSION

Scientific supports *Methi* (*Trigonella foenum-graecum*) comes out as well-supported nutraceutical with useful therapeutic implication to address *Prameha*and its clinical manifestation, Type 2 Diabetes Mellitus. Both experimental information and clinical research evidence indicate that fenugreek positively interferes with a number of metabolic processes. The postprandial glucose regulation activity of soluble fiber as galactomannan is identified to contribute to the delay of carbohydrate absorptions in the presence of glucose dependent insulin secretion to improve the peripheral insulin sensitivity of 4-hydroxyisoleucine. This cumulatively makes contributions towards measurable decreases in the fasting blood glucose, after meal effects and HbA1c. Fenugreek, together with hypoglycemic control, also demonstrates a stable lipid -lowering property primarily on total cholesterol and triglyceride levels suggesting a

healing effect of diabetic dyslipidemias and associated risk of Cardio-Vascular Disease. It has a good safety profile, as it had with the previous formulation, with minor and mild gastrointestinal side effects. Allowing normal levels of dietary intake of the standardized extract of fenugreek seed may prove to be a beneficial supplement to individuals who are on conventional antidiabetic treatment due to its safety, availability, and acceptability. *Methi*, as a component of a comprehensive approach to treatment, offers a logical, evidence based and cost-effective method of ensuring good metabolic control in the lives of diabetic patients.

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Table 1: Fenugreek nutritional value per 100 g

S.L No.	Nutrient	Amount per 100g
1	Calorie	323 kcal
2	Total Fat	6g,
3	Saturated Fat	1.5gm
4	Cholesterol	0 gm,
5	Sodium	67mg
6	Potassium	770 mg,
7	Dietary Fiber	25gm
8	Total Carbohydrate	58gm
9	Protein	23gm

Table 2: Percent daily value of selected nutrients

S.L.No	Nutrient	Percent daily value (%)
1	Vitamin C	5
2	Iron	186
3	Vitamin B6	30
4	Magnesium	47
5	Calcium	17
6	Vitamin D	0
7	Vitamin B12 (Cobalamin)	0

*Percent Daily Values are calculated based on a standard 2,000 kcal/day diet. Source: United States Department of Agriculture (USDA).

Table 3: Clinical trials consistently demonstrate the beneficial impact of Fenugreek on glycemic parameters:

Outcome Parameter	Observed Effect	Example Citation
Fasting Plasma Glucose (FPG)	Significant reduction (5-15%) across most trials.	[10]
Postprandial Glucose (PPG)	Marked reduction, often more pronounced than FPG reduction.	[7, 11]
Glycated Heamoglobin(HBA1C)	Modest but significant decrease (0.5% - 1.0%-point reduction) over 8-12 weeks.	[13]
Insulin Resistance (HOMA-IR)	Reduction observed, supporting the role of 4-OH Ile in improving sensitivity.	[8]

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