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"Evaluating the Efficacy of Methi (Fenugreek) Laddoos in Managing Blood Glucose Levels among Diabetic Adults Aged (40-70)"

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Abstract :

The present study evaluated the efficacy of methi laddoo as a dietary intervention for individuals with elevated blood glucose levels. While the intervention group demonstrated mild improvements in fasting and postprandial blood sugar levels, as well as slight reductions in weight and blood pressure in a subset of participants. The placebo group showed no notable changes in any measured parameter. The methi laddoo group demonstrated a mild overall improvement in glycemic control - 20% of participants showed a statistically significant reduction in fasting and postprandial blood sugar levels and 60% showed slight, non-significant improvements. In contrast, the placebo group showed no significant changes in glycemic parameters. Anthropometric Changes - in the methi laddoo group (30%) experienced modest weight loss ranging from 1 to 3 kg. Blood Pressure - A mild reduction in blood pressure (both systolic and diastolic) was observed in approximately 30–35% in the methi laddoo group. The findings suggest that methi laddoo may offer potential metabolic benefits particularly for glycemic and cardiovascular health in some individuals. The overall group mean showed a modest decline in glycemic parameters, the high standard deviation reflects inter-individual variability in response. This may suggest that the efficacy of methi laddoo as a dietary intervention could be influenced by factors such as baseline glycemic control, adherence, or individual metabolic differences.

Keywords : Fenugreek laddoos, Blood Glucose Level, type 2 diabetes

1. Introduction

Diabetes mellitus, particularly type 2 diabetes, is a chronic metabolic disorder characterized by elevated blood glucose levels due to insulin resistance or insufficient insulin production. (Zheng Y et., al 2018) Unlike type 1 diabetes, where the body produces little or no insulin, type 2 diabetes is often marked by insulin resistance—when cells don't respond properly to insulin. This leads to an accumulation of glucose in the blood, causing hyperglycemia. Over time, elevated blood sugar can lead to complications affecting the heart, kidneys, eyes, and nerves. Effective dietary interventions can play a crucial role in managing blood glucose levels, with certain functional foods showing promise in helping regulate these levels. (Martinez LC et., al. 2019)

Type 2 diabetes is influenced by a combination of genetic and lifestyle factors. It is more prevalent in individuals over 45, those with a family history of diabetes, and those who are overweight or physically inactive. However, lifestyle changes, including a balanced diet, regular exercise, and maintaining a healthy weight, can play a significant role in managing and even preventing the condition. Early detection and intervention are crucial, as they reduce the risk of long-term complications. Treatments for type 2 diabetes include lifestyle modifications, oral medications, and in some cases, insulin therapy. With proper management, individuals can lead healthy lives while minimizing the impact of diabetes on their overall well-being. (Florez JC et., al 2003)

In India, there is a deeply rooted tradition of utilizing complementary and alternative medicine (CAM) approaches, encompassing herbal remedies and dietary adjustments, to manage various health conditions, including diabetes. This reflects a long-standing cultural acceptance and reliance on natural products for promoting health and well-being. Among the various herbs used in traditional Indian medicine, fenugreek (*Trigonella foenum-graecum*), commonly known as "methi," holds a prominent position for its purported antidiabetic properties (Saxena A. et al.,2004). Fenugreek (*Trigonella foenum-graecum*), a staple in Indian diets, is well-regarded for its medicinal properties, particularly in managing blood glucose. Fenugreek seeds are rich in soluble fiber, specifically galactomannan, which slows glucose absorption in the intestines, thereby reducing postprandial blood sugar spikes (Manisha Modake et al.,2007). The seeds also contain 4-hydroxyisoleucine, an amino acid that stimulates insulin secretion and enhances insulin sensitivity. Research highlights the potential of fenugreek in reducing fasting glucose and HbA1c levels, making it a promising candidate for diabetes management found that daily fenugreek intake significantly reduced fasting blood glucose and HbA1c, suggesting its therapeutic potential for diabetics (Neelakantan et al. (2014).

Methi laddoo is a traditional Indian sweet preparation that utilizes fenugreek seeds ("methi dana") as its primary ingredient, often in combination with other components such as whole wheat flour, clarified butter (ghee), jaggery (or sugar), and frequently incorporating nuts and dried fruits (Singh A.B et al.,2010). Fenugreek seeds boast a rich nutritional profile, containing a substantial amount of dietary fiber (approximately 25%), protein (20-30%), and carbohydrates (40-60%). They are also a valuable source of essential minerals like iron, magnesium, manganese, potassium, phosphorus, and calcium, as well as various vitamins (Nazila Kassaian et.al., 2009). The antidiabetic effects attributed to fenugreek are linked to several bioactive compounds found in the seeds, including galactomannan (a soluble fiber), saponins, diosgenin, trigonelline, and 4-hydroxyisoleucine , which improve insulin sensitivity and lower blood glucose levels (Rashid R. et .al, (2019).

2. Rationale of the study:

Despite the prevalence of pharmaceutical options, dietary interventions remain critical for effective diabetes management, particularly in countries like India, where traditional dietary habits are deeply rooted in culture. Methi laddoos provide a feasible and culturally accepted way to incorporate antidiabetic ingredients like fenugreek and cinnamon into daily diets. However, there is limited empirical evidence on the direct impact of methi laddoos on blood glucose management in diabetics. Given the individual benefits of the ingredients, this study seeks to fill a gap by evaluating the combined effects of methi laddoos on glycemic control in diabetic adults, focusing on fasting and postprandial blood glucose levels, as well as HbA1c levels.

This background provides a foundation for understanding how the composition of methi laddoos could synergize to support blood glucose regulation in diabetics, highlighting the potential of culturally relevant dietary practices in managing chronic health conditions like diabetes

3. Back ground of the study

Type 2 diabetes mellitus is a prevalent chronic condition globally, with rapidly increasing cases attributed to lifestyle changes, dietary habits, and aging populations (Dianna J et al., 2021). Over time, having too much glucose in your blood can cause other health problems such as heart disease, nerve damage, eye problems, and kidney disease. You can take steps to prevent or manage diabetes NIH (NIDDK). Managing diabetes primarily involves lifestyle changes, dietary interventions, and medication. However, traditional dietary practices using functional foods, particularly in Indian culture, have shown potential as natural and sustainable management methods. The current review focuses on herbal drug preparations and plants used in the treatment of diabetes mellitus, a major crippling disease in the world leading to huge economic losses (Manisha Modake et al.,2007).

4. Purpose the study

The purpose of this study is to evaluate the efficacy of methi laddoos, a traditional Indian dietary preparation incorporating fenugreek seeds, cinnamon, and other nutrient-dense ingredients, in managing blood glucose levels among diabetic adults aged 40-70. Specifically, the study aims to assess whether daily consumption of methi laddoos can help reduce fasting blood glucose, postprandial glucose levels, and HbA1c values in this population.

By focusing on methi laddoos as a culturally relevant intervention, this study seeks to explore the potential for integrating traditional, functional foods into diabetes management practices. The findings may contribute to the development of evidence-based dietary recommendations that enhance glycemic control, offering an accessible, cost-effective, and culturally suitable option to support diabetes management for adults in India and similar cultural contexts.

Consuming methi laddoos may offer a sustainable approach to improving glycemic control, especially in middle-aged and older adults who are more likely to develop insulin resistance. However, traditional methi laddoos are often high in sugar (due to the use of jaggery) and made with whole wheat flour, which may not be suitable for diabetic individuals aiming to regulate their carbohydrate intake, hence we have made slight changes in the preparation of the laddoos.

5. Overview of the Study

To evaluate the efficacy of methi laddoos, a randomized, placebo-controlled trial was conducted with 50 participants diagnosed with Type 2 diabetes. Participants were randomly divided into two groups:

- **Group 1 (n=25):** Received methi laddoos daily for a specified period.
- **Group 2 (n=25):** Received a placebo diet that looked and tasted similar to the methi laddoo but did not contain fenugreek.

The study monitored changes in fasting blood glucose (FBG), postprandial blood glucose (PPBG), and HbA1c levels over time, comparing the outcomes between the two groups.

6. Materials and Methodology :

Materials and Instruments Used

- **Accu-Chek Glucometer** (for blood glucose estimation)
- **Dr. Morepen Digital BP Monitor** (for blood pressure measurement)
- **Digital Weighing Scale** (for body weight measurement)

Fig No.7: weighing machine

Fig No.8: glucometer and BP machine

6.1 Study Design and Sampling Technique

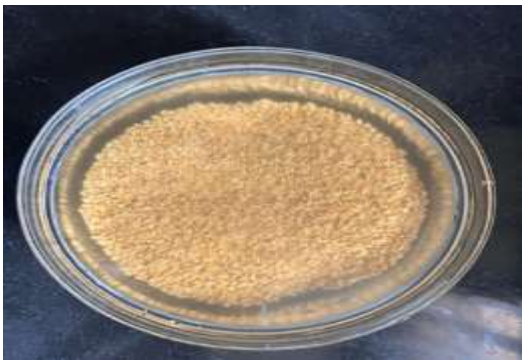
This study employed a quasi-experimental design comprising two parallel groups: an intervention group receiving methi (fenugreek) laddoos and a control group receiving placebo laddoos. A total of 50 participants were selected through convenience sampling. The sample was divided equally between the two groups, with 25 individuals in the intervention group and 25 in the placebo group. Initial attempts to recruit participants from local clinics were unsuccessful due to scheduling conflicts and geographical constraints. Therefore, participants were recruited from the researcher's residential neighborhood.

Inclusion criteria encompassed adults diagnosed with Type 2 Diabetes Mellitus, who were not suffering from any other serious medical conditions. Participants with known food allergies, renal complications (such as nephrolithiasis or cholelithiasis), or those undergoing any restrictive dietary therapy were excluded. All participants provided informed consent prior to their inclusion in the study.

6.2 Preparation of Intervention and Placebo Laddoos:

Since we have change the recipe, to make nutritious methi laddoos, soaked fenugreek seeds in water overnight and germinated fenugreek seeds, which helps reduce the bitterness of fenugreek and enhances the bioavailability of its active compounds. Once germinated, shadow dry the seeds to preserve their nutrients. Roast the dried fenugreek seeds lightly for 4-5minutes to reduce bitterness.

Fig No. 1: Process of Making Loddoos



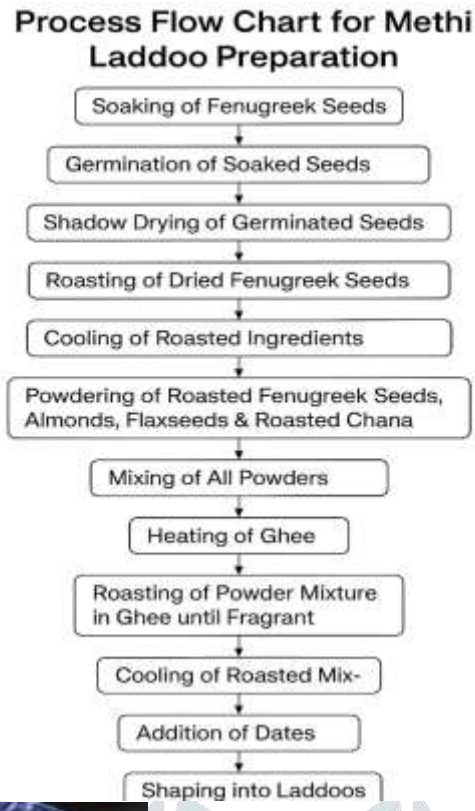


Fig No. 2: Soaked fenugreek seed

The laddoos were prepared for a 30-day intervention period, with each participant receiving 30 laddoos (one per day). The formulation for the methi laddoo (intervention group) and placebo laddoo (control group) was as follows:

Intervention Group (Methi Laddoo):

Ingredients (per 30g serving):	**Nutrient Amount**
• Fenugreek (Methi) Powder – 8g • Roasted chana-5gm • Almond Powder – 5g • Dates (Gud) –5g • Ghee (Clarified Butter) – 5g • Flaxseeds Powder – 2g	• Energy - 148 kcal • Protein - 4.5gm • Carbohydrates - 7.3g • Fiber - 4g • Fats - 9.4g

Table No.1: Nutritive Value of Fenugreek laddoo

Fig No.4: weight of Fenugreek laddoo

Fig No. 5: weight of Besan Laddoo

Placebo Group (Control Laddoo):

• **Ingredients (per 30g serving):**	**Nutrient Amount**
• Baesan- 8gm • Flaxseeds-2 gm • Almonds powder-5gm • Dates-8gm • Ghee-5gm	• Energy 141 kcal • Protein 3.4g • Carbohydrates 10g • Fiber 3.0gm • Fats 9.1 gm

Table No. 2 Nutritive Value of Besan laddoo

To mimic the taste and appearance of methi laddoos, the besan and flaxseeds in the placebo group were roasted until golden brown to compensate for the absence of fenugreek, which imparts a characteristic color and bitterness.

6.3 Target Population

The target population consists of adults aged 40-70 with type 2 diabetes. This age range is chosen due to the high prevalence of diabetes in middle-aged and older adults and the specific need for effective dietary strategies for blood glucose management in this group.

6.4 Study Site

The study will be conducted in local clinics/hospitals and neighbouring areas to facilitate participant recruitment, follow-up visits, and accessibility to medical support for blood glucose testing.

6.5 Data Collection and Baseline Measurements

Eligible participants were visited at home, where the researcher explained the study protocol in detail. After obtaining consent, the following baseline measurements were taken:

- Random Blood Sugar (RBS)
- Pre-prandial and Post-prandial Blood Glucose Levels, using an Accu-Chek digital glucometer
- Blood Pressure, recorded using a Dr. Morepen digital sphygmomanometer
- Body Weight, measured with a digital battery-powered weighing machine

Fig No. 6: Collection of blood sample and monitoring BP

Participants were also asked to share results from any recent biochemical tests, if available, to support baseline assessment. Each participant received individualized dietary counselling, focusing on the importance of reducing high-carbohydrate food intake and adhering to the laddoo regimen. Participants were instructed to consume one laddoos every morning on an empty stomach throughout the study period.

6.6 Follow-Up and Monitoring

A midpoint follow-up was conducted after 15 days to assess participant compliance and identify any adverse reactions such as constipation, nausea, vomiting, or other gastrointestinal discomforts. At the end of the 30-day intervention, the following parameters were reassessed:

6.6.1 Pre-prandial and Post-prandial Blood Glucose Levels

These measurements were taken using the same device and under similar conditions as the baseline assessment to ensure data consistency.

6.6.2 Participant Demographics

- **Intervention Group (Methi Laddoo):** 14 females and 11 males
- **Control Group (Placebo Laddoo):** 12 females and 13 males

7. Results and Discussion :

7.1 Participant Retention and Compliance

In the intervention group (methi laddoo), 5 out of 25 participants (20%) withdrew from the study. Therefore, the final analysis was conducted on 20 participants. In contrast, all 25 participants in the control group (placebo laddoo) completed the 30-day intervention, achieving a 100% compliance rate.

Intervention Group (Methi Laddoo):

- Among the 20 participants who completed the study:
  - 4 participants (64%) exhibited a significant reduction in both pre-prandial and post-prandial blood glucose levels.
  - 12 participants (25%) showed a mild or slight improvement in glucose levels.
  - 4 participants (11%) demonstrated no improvement; in fact, these individuals experienced a marginal increase in blood glucose levels by the end of the intervention.

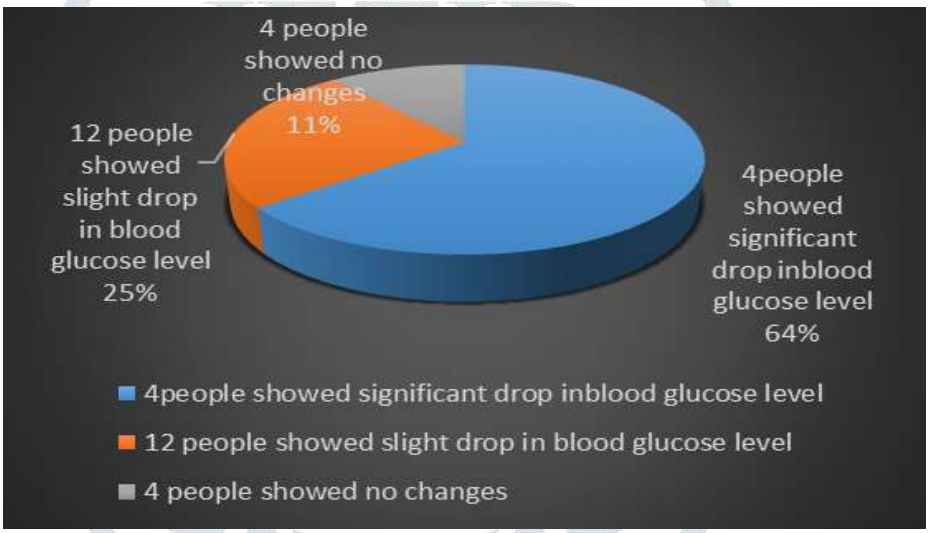


Fig no.9: Pie chart depicting data in percentages in intervention group

Response Category	Methi Laddoo Group (n=20)	Control Group (n=25)
Significant decrease in glucose levels	4 (64%)	0 (0%)
Slight decrease in glucose levels	12 (25%)	5 (20%)
No change or increase in glucose	4 (11%)	20 (80%)

Table no.3: Results of Intervention group &n control group

Control Group (Placebo Laddoo):

- Of the 25 participants:
  - 5 participants (20%) showed slight reductions in blood glucose levels.

- The remaining 20 participants (80%) exhibited no noticeable change in their pre- or post-prandial glucose readings.

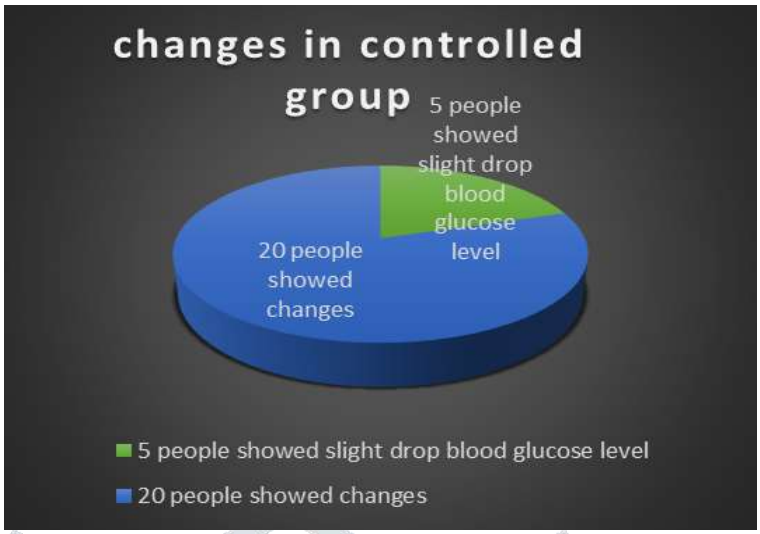


Fig no. 10 : Pie chart depicting changes in controlled group

7.2 Effect on Weight and Blood Pressure

Across both the intervention and control groups, no statistically significant changes were observed in body weight or blood pressure readings throughout the 30-day study period. Measurements taken before and after the intervention remained within the same range for all participants.

Parameter	Intervention group(mean± SD)	Control group mean± SD)
Weight loss	6(30%) lost 1-3 kg in month	No changes
Mean weight changes	Minimal not statically significant (p>0.5)	No changes
BMI	Slight decline in few participants	No changes

Table No: 4 Parameter of weight and BMI

7.3 Effect on Blood pressure

Parameter	Intervention group(mean± SD)	Control group mean± SD)
Systolic BP	6-7 showed miled reduction	No changes
Diastolic BP	Same as above	No changes
Statistical significance	Not significant(p>0.0)	-

Table No. 5: Parameter of blood pressure

7.4 Analysis:

7.4.1. Participant Retention and Compliance

The study initially enrolled 50 participants, equally divided into the methi laddoo intervention group and the placebo group. The intervention group had a dropout rate of 20% (5 out of 25), primarily due to taste aversion or personal inconvenience. All participants in the placebo group completed the study, indicating higher compliance with the placebo intervention. The higher dropout rate in the intervention group could reflect issues related to palatability or adherence to dietary changes.

7.4.2. Glycemic Control

- The methi laddoo group demonstrated a mild overall improvement in glycemic control:
- 20% of participants (4 out of 20) showed a statistically significant reduction in fasting and postprandial blood sugar levels.
- 60% showed slight, non-significant improvements.
- The remaining 20% exhibited no change.
- HbA1c showed a slight decline in the intervention group but was not statistically significant.

In contrast, the placebo group showed no significant changes in glycemic parameters. Only 5 participants exhibited a slight decrease in blood glucose levels, which may be attributed to normal daily variations or placebo effect.

These findings suggest a potential glycemic benefit of methi laddoo in some individuals, although the overall effect across the group was not statistically significant. Inter-individual variability and short duration of the intervention may have contributed to these outcomes

7.4.3. Anthropometric Changes

Only 6 participants in the methi laddoo group (30%) experienced modest weight loss ranging from 1 to 3 kg. The average weight and BMI reduction across the group were minimal and not statistically significant. No weight or BMI change was observed in the placebo group.

This indicates that while methi laddoo may assist in mild weight loss for some individuals, its impact over a one-month period was limited and inconsistent.

7.4.4. Blood Pressure

A mild reduction in blood pressure (both systolic and diastolic) was observed in approximately 6–7 participants (30–35%) in the methi laddoo group. However, the changes did not reach statistical significance. No change in blood pressure was observed in the placebo group.

This again suggests a possible benefit of methi laddoo on cardiovascular parameters in select individuals, but a larger sample size and longer duration would be necessary to validate these findings.

7.4.5 Statistical Analysis of Intervention Group

Paired t-tests were conducted to compare the pre- and post-intervention measurements in the methi laddoo group (n = 20). The analysis revealed statistically significant improvements in both fasting (pre-prandial) and postprandial blood glucose levels after the 30-day intervention. However, there were no significant changes observed in body weight.

•Pre-Prandial Glucose:

The mean fasting glucose level before the intervention was 231.61 ± 46.68 mg/dL, which significantly decreased to 192.20 ± 42.65 mg/dL post-intervention. A paired t-test showed this reduction to be statistically

significant, t(19) = 3.84, p = .0011.The 95% confidence interval (CI) for the mean difference ranged from -60.88 to -17.93 mg/dL.

•Post-Prandial Glucose:

The mean post-meal glucose level dropped from 306.86 ± 48.11 mg/dL to 261.29 ± 51.23 mg/dL. This change was statistically significant, t (19) = 4.54, p = .0002.

The 95% CI for the difference was -66.58 to -24.56 mg/dL.

•Weight:

The mean body weight increased slightly from 70.96 ± 13.39 kg to 71.48 ± 12.24 kg. However, this difference was not statistically significant, t (19) = -0.28, p = .7812. The 95% CI for the weight change ranged from -3.37 to 4.42 kg.

Paired t-test Results for Intervention Group (n = 20)

Parameter	Mean (Before) ± SD	Mean (After) ± SD	t-value	p-value	95% CI for Difference	Significance
Pre-Prandial Glucose	231.61 ± 46.68	192.20 ± 42.65	3.84	0.0011	(-60.88, -17.93	✓ Yes
Post-Prandial Glucose	306.86 ± 48.11	261.29 ± 51.23	4.54	0.0002	(-66.58, -24.56	✓ Yes
Weight (kg)	70.96 ± 13.39	71.48 ± 12.24	-0.28	0.7812	(-3.37, 4.42)	✗ No

Table No.6: Statistical Analysis

7.5 Discussion :

This study investigated the potential metabolic benefits of methi laddoo consumption over a one-month intervention period, focusing on glycemic control, cardiovascular health, and weight management and found that methi laddoo have potential to lower blood glucose level along with dietary modification and improved lifestyle.

Pre and post prandial glucose level and HbA1c are standard parameters indicators and clinical testimony by the American Diabetes Association (ADA). The integration of fenugreek (*Trigonella foenum-graecum*) in traditional Indian sweets such as methi laddoos offers a promising, culturally embedded approach to dietary management of diabetes mellitus. Numerous studies have highlighted fenugreek's potential in regulating blood glucose levels, largely attributed to its high fiber content, saponins, and alkaloids like trigonelline and 4-hydroxyisoleucine, which modulate insulin activity and glucose absorption (Basch et al., 2003)

In particular, fenugreek seeds have demonstrated efficacy in improving glycemic control among individuals with type 2 diabetes. Meta-analyses have reported significant reductions in fasting blood glucose and HbA1c levels with daily fenugreek supplementation, especially when consumed in doses ranging from 5 to 100 grams per day (Sharma R.D.et al., 1990; Neelakantan et al., 2014). These results support the hypothesis that regular intake of fenugreek in food forms like methi laddoos may offer sustained glucose-lowering benefits.

Moreover, methi laddoos represent a culturally acceptable and easily accessible method of incorporating fenugreek into the diet. Cultural familiarity can significantly influence dietary adherence, a critical factor in chronic disease management (Satija et al., 2015). This is particularly relevant in South Asian populations, where

the burden of diabetes is high and where integrating therapeutic foods within traditional dietary patterns may improve compliance and overall effectiveness of lifestyle interventions (Misra et al., 2011).

Traditional formulations like methi laddoos not only deliver the benefits of fenugreek but often include other functional ingredients such as jaggery, ghee, and dry fruits, which may have synergistic or antagonistic effects on glycemic response. While ghee and jaggery add caloric density, their moderate use within a balanced dietary pattern may still support glycemic control, particularly when portion sizes are monitored (Joshi et al., 2017)

However, despite the promising theoretical framework and individual studies on fenugreek, there remains a paucity of clinical research directly evaluating the glycemic effects of methi laddoos as a food-based intervention. Controlled trials assessing both short-term and long-term metabolic outcomes following the consumption of methi laddoos in diabetic populations are essential to validate their clinical use.

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