



# Antihyperglycemic Effect of *Moringa Oleifera* Leaf Powder on Fasting Blood Sugars: A Retrospective Cross over Study

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## Introduction

Diabetes mellitus and obesity are major health issues in India. Prevalence studies have estimated that around 6–12% of urban and 2–3% of rural Indians are diabetic. Type II diabetes (NIDDM) is the most common type of diabetes. It is associated with older age, obesity, family history, physical inactivity, and ethnicity [1].

The use of local plant materials for the treatment of infectious and non-infectious diseases is widely developed in the traditional medicine of tropical countries. Such plants have enormous therapeutic potential and have been traditionally used to treat various diseases (e.g., malaria, asthma, dysentery, ulcers, diarrhoea, and type 2 diabetes mellitus) [2]. The World Health Organization (WHO) has listed 21,000 plants that are used for medicinal purposes around the world. Among these 2500 species are in India, out of which 150 species are used commer-

cially on a fairly large scale [3]. For medical systems, managing diabetes with fewer or no adverse effects remains a problem. Herbal remedies are excellent body balancers that assist its natural balancing process, help regulate physiological processes, and provide nutrients that are lacking from a bad diet or environmental inadequacies in the soil and air [11]. The use of herbal medicines for the prevention or treatment of T2DM has thus gained importance throughout the world. Various studies have been conducted on a selection of plant extracts that have had promising results for the prevention and treatment of chronic non-infectious diseases. These plants are said to contain substances that possess anti-hyperglycemic, anti-hyperlipidemic, and anti-hypoproteinemic properties [4]. Most plants contain carotenoids, flavonoids, terpenoids, alkaloids, glycosides and can often have anti-diabetic effects [9]. The anti-hyperglycemic effects that result from treatment with plants are often due to their ability to improve the performance of pancreatic tissue,



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which is done by increasing insulin secretions or reducing the intestinal absorption of glucose [10].

In the Indian traditional system of medicine, *Moringa oleifera* Lam. Syn. (Moringaceae) is commonly known as a healing herb, tree of life, and God's Gift to man [1,7]. *Moringa oleifera* Lam is native to south Asia but grows in tropical Africa and Latin America [1]. *Moringa oleifera* leaves are dense in nutrients and rich in phytochemicals. They contain substantial levels of protein, with a balanced amino acid composition and have several micronutrients, including the B vitamins [5]. It also possesses high phenolic content and potent antioxidant properties [6]. Different parts of this plant are used in the indigenous systems of human medicine for the treatment of a variety of human ailments. It is also suggested that low concentrations of the *Moringa oleifera* plant extract can be used for the regulation of thyroid hormone metabolism [8]. The leaves of *Moringa oleifera* are reported to be used as a hypocholesterolemic and hypoglycemic agent [3]. When used as a diet supplement for diabetics, lesser doses of the *Moringa oleifera* plant may have higher medical advantages [7]. *Moringa oleifera* leaf powder is recommended not only for people with diabetes but also for the general public, who are health conscious to keep away the prevalence of such chronic disorders as a preventable measure [3]. The purpose of this research is to look into the antihyperglycemic effects of *Moringa oleifera* leaf powder (MOLP) on fasting blood glucose of people with T2DM.

### Methodology

Participants in this crossover study are those who enrolled in Sugarfit's diabetes reversal and management programme (SDRMP). SDRMP is a comprehensive programme for managing and reversing diabetes that uses an evidence-based, individualised approach to help people with type 2 diabetes and prediabetes. Using a glucometer, participants were requested to conduct Self-Monitored Blood Glucose (SMBG). It is a portable instrument that is used to monitor blood glucose levels by pricking the finger tip with a lancing device and collecting a drop of blood on a strip that is then placed inside the glucometer prior to the prick. The subjects had to undergo a fasting SMBG test during the study period, which continued for a total of six days. They were instructed to conduct a fasting blood glucose test for the first three days without ingesting MOLP, and then for the following three days they were instructed to conduct a fasting blood glucose test while ingesting 0.25g/kg body weight (roughly 15-25g) of MOLP. To prevent participants from experiencing hypoglycemia symptoms right away, it was advised to consume the prescribed amount of MOLP two or three times a day. The powder was recommended to be consumed in whichever way the user preferred to- including in soup, smoothies, salad or sabzis, diluted in 200 ml of plain water or buttermilk, but the majority of participants chose to consume the powder with buttermilk or water. Additionally, they were requested to enter the results of their fasting SMBG tests on the Sugar Fit app. The ones taking anticoagulants, and with diabetes-related complications like cardiovascular disease, nephropathy, neuropathy, retinopathy, and liver diseases were excluded and those individuals who did not tolerate the taste of moringa, were allergic to it, or experienced any other concerning side effects like vomiting, diarrhoea, or constipation and/or did not continue the intervention for three successful days were eliminated from the study. Participants were observed retrospectively during six days of the study period. The subjects had an average baseline Hba1c of 7.24±1.3%, an average weight of 74.72±13.4 kg, and

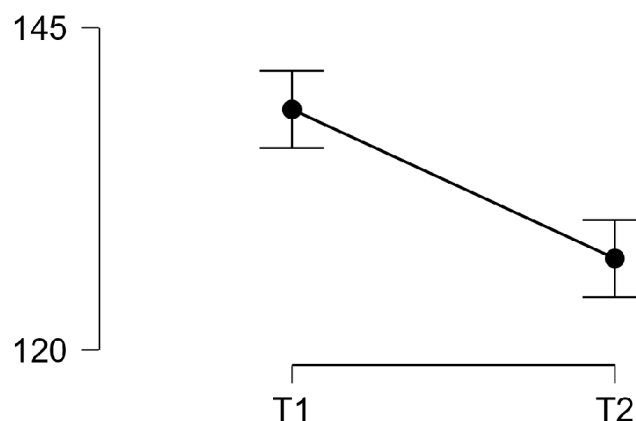
a BMI of 26.4±4.1. There were 33 males and 13 female participants, with an average age of 48.52±8.8 years. The study's findings include a comparison of fasting blood sugar levels before and after consumption of MOLP as well as an overall drop in fasting blood sugar levels.

**Table 1:** Baseline characteristics of study participants.

Age in years	48.5 ± 8.8
Sex	Male, n= 33 Female, n= 13
Hba1c in %	7.24±1.3
Weight in kgs	74.72±13.4
BMI	26.4±4.1

### Results

Baseline characteristics of the participants, including age, gender, initial Hba1c, and weight of the participants are given in Table 1. All the participants were diagnosed with type 2 diabetes and self enrolled in sugarfit's diabetes reversal and management program. Data from 46 participants who consumed MOLP for 3 days was collected and analysed. The average FBS before taking MOLP was 138.6±35.05 mg/dL and average FBS after taking MOLP is 127.1±29.5 mg/dL respectively. There was 9.2±10.6 mg/dL point reduction in FBS after the consumption of MOLP (Figure 1). Paired T test was performed in order to check the significant difference between before and after supplementation of MOLP, A Wilcoxon signed rank test and student t test were performed where there is significant difference between T1 and T2 at p<0.001 level of significance (Table 2).



**Figure 1:** Significant difference in FBS before and after consumption of MOLP.

Where T1: Average FBS before MOLP supplementation T2: Average FBS after MOLP supplementation

**Table 2:** Significant difference in FBS before and after consumption of MOLP.

Test	Measure 1	Measure 2	p
Student	T1	T2	<0.001
Wilcoxon signed-rank			<0.001

Where T1: Average FBS before MOLP supplementation T2: Average FBS after MOLP supplementation.

### Discussion

Fasting blood glucose has been reported to reduce the risk of vascular disease at all concentrations, including below the threshold for diabetes of 126 mg/dL (7 mmol/L) [12]. Therefore, lowering FBS is more crucial for the management of diabetes.

*Moringa oleifera* has reportedly been associated with a hypoglycemic impact in Indian traditional medicine. After consuming moringa, a decrease in FBS concentrations was seen in 2-3 months compared to the initial figure [2,13]. Research states that by reducing the expression of the pyruvate carboxylase enzyme in the liver and by regenerating injured pancreatic cells and hepatocytes through its antioxidant activities, an aqueous preparation of moringa leaves demonstrated hypoglycemic properties [14,15]. This study has shown that adding 0.25 g/kg of MOLP (about 15 to 25 g) to a diet can reduce blood sugar levels. FBS was reduced by a total of 11 points when compared to the baseline FBS without MOLP supplementation. The average FBS before taking MOLP was 138.6±35.05 mg/dL; after taking MOLP as a supplement, the FBS on the first, second, and third days was 130.86±35.03 mg/dL, 125±28.38 mg/dL, and 125±30.1 mg/dL respectively (Table 3). The average decline in FBS is seen 48 hours after beginning with MOLP. Five participants witnessed an increase in FBS after receiving MOLP supplementation, although the majority of subjects noticed a decrease. This could be because of the type of food consumed for supper, meal time, physical activity and sleep. According to research studies, consumption of *Moringa oleifera* leaf extract lowers insulin resistance, encourages weight reduction, lowers LDL cholesterol, and regulates postprandial blood glucose levels. The reduction in FBS relies on a number of other factors in addition to the consumption of moringa leaf powder, including medications, meals, the duration of sleep, physical activity etc. Throughout the study period, health coaches collected the FBS readings via daily follow-up calls; nevertheless, there is always a risk that a human error occurred during the recording of these readings. The amount of MOLP consumed presents another difficulty for this investigation. Since none of the users had food weighing scales, serving sizes were advised using teaspoons, additionally, it is possible that the recommended dosage were taken incorrectly. The bitter taste of the MOLP also posed a challenge in this research, resulting in the decrease of study participants.

**Table 3:** Average FBS for 3 days after consumption of MOLP.

Days of MOLP consumption	Average FBS
Day 1	130±35.03
Day 2	125±28.38
Day 3	125±30.1

### Conclusion

Fasting blood glucose is the amount of glucose present in the blood after fasting for 8 to 12 hours; it is usually measured soon after waking up from bed in an empty stomach. Elevated Fasting blood sugar level in people with type 2 diabetes is the risk factor for other diabetes related complications; hence getting the FBS into the normal range is prioritised during the management of type 2 diabetes. Elevated FBS may be due to the impact of various factors such as sleep, medications, physical activity, infections, stress, hormonal changes, and many others. *Moringa oleifera* is a shrub which is known for its antidiabetic property, and it is also rich in micronutrients, hence its recommendation as a nutrition supplement. This retrospective crossover study indicates that the dietary supplementation of MOLP has a positive blood glucose regulatory effect by lowering fasting blood glucose levels.

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