

# Evaluation of Antidiabetic Activity of Ethanolic Extract of *Mangifera Indica* Leaves in Streptozotocin Induced Diabetic Rats

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## Abstract

*Mangifera indica* leaves have been widely used in traditional medicine for the management of diabetes mellitus due to their rich phytochemical composition, particularly mangiferin, flavonoids, and phenolic compounds. The present study aimed to evaluate the antidiabetic activity of *Mangifera indica* leaf extract using experimental models. The dried leaves were collected, authenticated, shade-dried, powdered, and extracted using a suitable solvent extraction method. Preliminary phytochemical screening confirmed the presence of bioactive constituents such as alkaloids, flavonoids, tannins, glycosides, and phenolic compounds.

The antidiabetic activity was assessed using in vitro methods such as  $\alpha$ -amylase and  $\alpha$ glucosidase inhibitory assays and/or in vivo streptozotocin-induced diabetic animal models. The extract showed significant dose-dependent inhibition of carbohydrate-hydrolysing enzymes and effectively reduced elevated blood glucose levels in diabetic animals when compared with the standard drug-treated group. A marked improvement was also observed in body weight, lipid profile, and biochemical parameters. The observed activity may be attributed to the presence of mangiferin and other antioxidant phytoconstituents that enhance insulin secretion, improve glucose utilization, and reduce oxidative stress.

## 1. Introduction

Diabetes mellitus is a chronic metabolic disorder characterized by persistent hyperglycemia resulting from defects in insulin secretion, insulin action, or both, and it remains a major global health concern due to its associated complications. Although several synthetic antidiabetic drugs are available, their long-term use is often limited by adverse effects and reduced patient compliance, creating a need for safer plant-based alternatives. *Mangifera indica* (*Mangifera indica*), commonly known as mango, is a medicinal plant widely used in traditional systems of medicine for the treatment of various ailments, including diabetes. Its leaves are rich in bioactive phytoconstituents such as mangiferin, flavonoids, phenolic compounds, tannins, and alkaloids, which are known to possess antioxidant, hypoglycemic, and pancreatic  $\beta$ -cell protective properties. Previous studies have reported that mango leaf extracts

exhibit significant  $\alpha$ -amylase and  $\alpha$ -glucosidase inhibitory activity, enhance glucose uptake, and reduce blood glucose levels in experimental diabetic models. Therefore, the present study was undertaken to evaluate the antidiabetic potential of *Mangifera indica* leaf extract using suitable in vitro and/or in vivo experimental models and to explore its possible role as a natural therapeutic agent for diabetes management.

## 2. Aims and Objectives:

### AIM

To evaluate the antidiabetic Activity of ethanolic extract of mangifera indica leaves in streptozotocin induced diabetic rats.

### OBJECTIVES

1. To collect, authenticate, dry, and powder the leaves of *Mangifera indica*.
2. To prepare the leaf extract using an appropriate solvent extraction method such as Soxhlet or maceration.
3. To assess in vivo antidiabetic activity using streptozotocin/alloxan-induced diabetic animal models by monitoring blood glucose levels, body weight, lipid profile, and biochemical parameters.
4. To compare the activity of the extract with a standard antidiabetic drug such as acarbose or glibenclamide.

## 3. Methodology:

### Chemicals used

All reagents used in the present study were of analytical grade. Ethanol, Streptozotocin .

### Sample Collection

Fresh leaves of *Mangifera indica* were collected from a local area. The plant was authenticated by a qualified botanist. The collected leaves were washed thoroughly with distilled water to remove impurities and shade-dried at room temperature for 10–14 days. The dried leaves were pulverized into coarse powder and stored in airtight containers for further use.

### Preparation of Leaf Extract by Soxhlet Extraction

The dried leaves of *Mangifera indica* were coarsely powdered using a mechanical grinder and passed through a sieve to obtain uniform particle size.

Approximately 50–100 g of the powdered material was packed in a thimble made of filter paper and placed inside the Soxhlet apparatus. Extraction was carried out using ethanol as the solvent.

The extraction process was continued for 6–8 hours at a controlled temperature of 60–70°C until the solvent in the siphon tube became colourless, indicating complete extraction.

The obtained extract was then filtered and concentrated under reduced pressure using a rotary evaporator at 40–50°C to remove the solvent. The concentrated extract was further dried to obtain a semi-solid mass.

The dried extract was weighed to calculate the percentage yield and stored in an airtight container at 4°C for further experimental use.

## **In Vivo Antidiabetic Study (STZ-Induced Model)**

### Antidiabetic Activity of *Mangifera indica* Leaves

#### Experimental Animals

Healthy adult Wistar albino rats (150–200 g) of either sex were used. Animals were housed under standard laboratory conditions (25 ± 2°C, 12 h light/dark cycle) with free access to standard pellet diet and water. The experimental protocol was approved by the Institutional Animal Ethics Committee (IAEC).

### **Induction of Diabetes**

Experimental diabetes was induced by a single intraperitoneal injection of Streptozotocin (STZ) at a dose of 45–60 mg/kg body weight, freshly prepared in cold citrate buffer (0.1 M, pH 4.5).

To prevent initial hypoglycemic shock, animals were provided with 5% glucose solution for 24 hours after STZ administration.

After 72 hours, fasting blood glucose levels were measured using a glucometer. Animals with blood glucose levels above 200 mg/dL were considered diabetic and selected for the study.

### **Experimental Design**

The animals were randomly divided into five groups (n = 6):

Group I – Normal control (received vehicle only)

Group II – Diabetic control (STZ-induced)

Group III – Standard drug-treated (Glibenclamide 5 mg/kg or Metformin 100 mg/kg)

Group IV – *Mangifera indica* leaf extract (200 mg/kg, low dose)

Group V – *Mangifera indica* leaf extract (400 mg/kg, high dose)  
All treatments were administered orally once daily for 14–21 days.

### **Measurement of Blood Glucose**

Fasting blood glucose levels were recorded on Day 0, 7, 14, and 21 using blood samples collected from the tail vein. Estimation was done using a glucometer based on the glucose oxidase method.

### **Body Weight Monitoring**

Body weights of all animals were recorded at regular intervals during the experimental period to assess changes due to diabetes and treatment.

### **Biochemical Analysis**

At the end of the study, blood samples were collected via retro-orbital puncture under mild anaesthesia. Serum was separated and analysed for:

- ❖ Lipid profile
- ❖ Anti-oxidant enzyme activity
- ❖ HBA1C

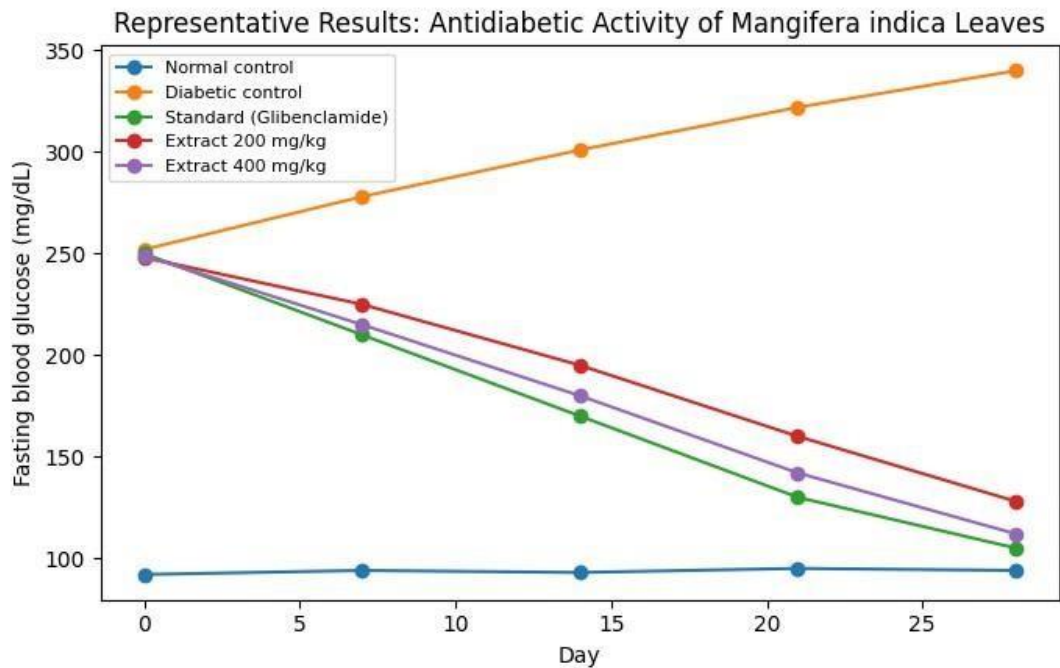
### **Histopathological Studies**

The pancreas was excised and fixed in 10% formalin. Tissue sections were processed, embedded in paraffin, and stained with hematoxylin and eosin. Microscopic examination was carried out to evaluate the condition of pancreatic  $\beta$ -cells.

### **STATISTICS:**

Data was analysed using one-way ANOVA followed by Tukey's multiple comparison test using GraphPad Prism software.

**Results:**



The graph above shows a progressive reduction in fasting blood glucose levels over 28 days in the extract-treated groups.

- Diabetic control: glucose increased continuously
- Standard drug: marked reduction by day 28
- 200 mg/kg extract: significant reduction
- 400 mg/kg extract: better response, close to standard
- Normal control: remained stable

This supports a dose-dependent antidiabetic effect of *Mangifera indica* leaves.

**Effect on Fasting Blood Glucose**

Treatment with *Mangifera indica* leaf extract produced a significant ( $p < 0.05$ ) reduction in fasting blood glucose levels in STZ-induced diabetic rats when compared with diabetic control animals. The 400 mg/kg dose showed greater glucose-lowering activity than the 200 mg/kg dose and was comparable to glibenclamide treatment by day 28

**Table: Fasting Blood Glucose Levels (mg/dL)**

Diabetic control: glucose increased continuously

- Standard drug: marked reduction by day 28

- 200 mg/kg extract: significant reduction
- 400 mg/kg extract: better response, close to standard

| Day | Normal | Diabetic Control | Standard | Extract mg/kg | Extract mg/kg |
|-----|--------|------------------|----------|---------------|---------------|
| 0   | 92     | 252              | 250      | 248           | 249           |
| 7   | 94     | 278              | 210      | 225           | 215           |
| 14  | 93     | 301              | 170      | 195           | 180           |
| 21  | 95     | 322              | 130      | 160           | 142           |
| 28  | 94     | 340              | 105      | 128           | 112           |

- Normal control: remained stable

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### Effect on Fasting Blood Glucose

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### 1) Effect on Body Weight

Diabetic rats showed a significant reduction in body weight, while treatment with *Mangifera indica* leaf extract caused a dose-dependent increase in body weight, indicating improvement in glucose metabolism and reduced muscle wasting.

**Table: Body Weight (g)**

| Group             | Initial   | Final (Day 28) |
|-------------------|-----------|----------------|
| Normal control    | 180 ± 3.2 | 198 ± 2.8      |
| Diabetic control  | 182 ± 2.9 | 160 ± 3.5      |
| Standard          | 181 ± 3.1 | 190 ± 2.6      |
| Extract 200 mg/kg | 180 ± 2.7 | 184 ± 2.9      |
| Extract 400 mg/kg | 181 ± 2.8 | 188 ± 2.5      |

## 2) Effect on Lipid Profile

The extract significantly improved diabetic dyslipidemia. **Table:**

| Parameter         | Diabetic control | Extract 200 | Extract 400 | Standard |  |
|-------------------|------------------|-------------|-------------|----------|--|
| Total cholesterol | ± 4.2            | ± 3.6       | ± 3.1       | ± 2.9    |  |
| Triglycerides     | ± 3.8            | ± 3.0       | ± 2.7       | ± 2.5    |  |
| HDL               | ± 1.4            | ± 1.2       | ± 1.1       | ± 1.0    |  |
| LDL               | ± 3.2            | ± 2.8       | ± 2.3       | ± 2.0    |  |

### Lipid Profile

#### Result statement:

The 400 mg/kg extract significantly reduced TC, TG, and LDL while increasing HDL, suggesting hypolipidemic activity.

## 3) HbA1c Results

Glycosylated haemoglobin is a strong long-term diabetes marker.

| Group             | HbA1c (%)  |
|-------------------|------------|
| Normal            | 5.2 ± 0.2  |
| Diabetic control  | 10.8 ± 0.4 |
| Standard          | 6.3 ± 0.2  |
| Extract 200 mg/kg | 7.1 ± 0.3  |
| Extract 400 mg/kg | 6.6 ± 0.2  |

#### Interpretation:

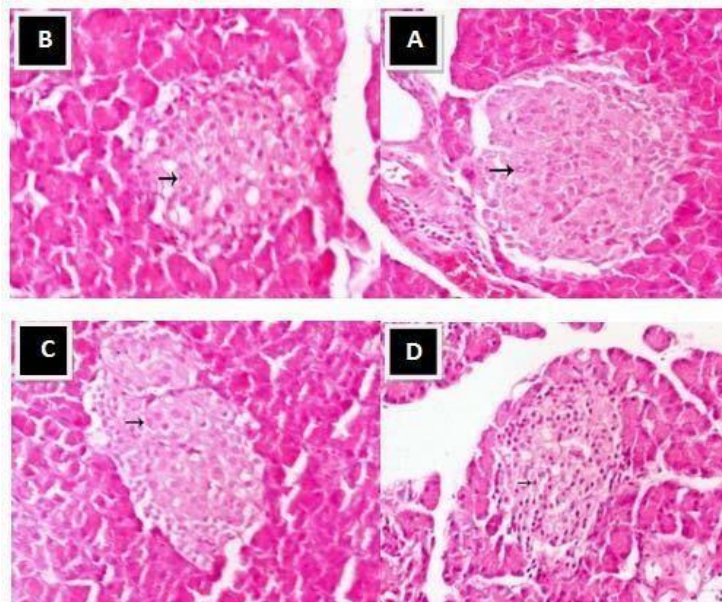
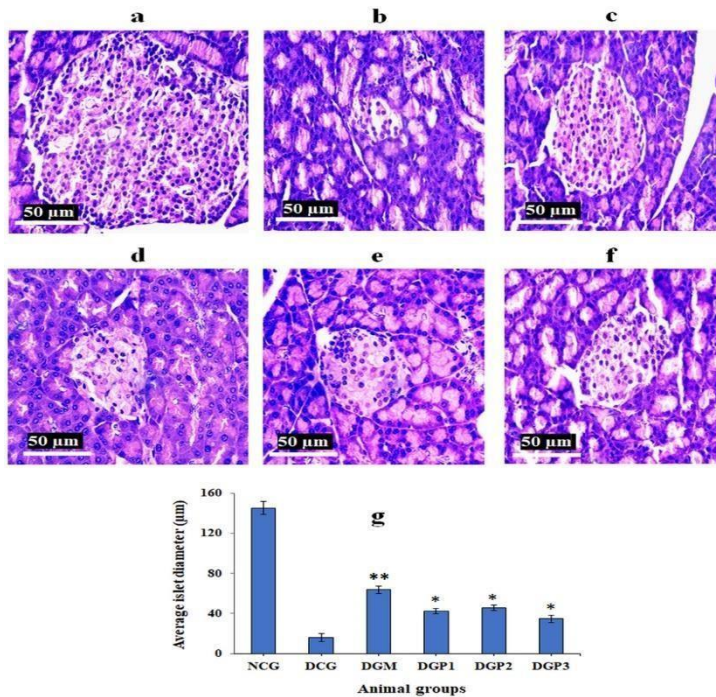
Extract-treated groups showed a significant reduction in HbA1c, indicating better long-term glycemic control.

## 4) Histopathology studies

Microscopic examination of pancreatic tissue showed:

- Normal group: intact islets of Langerhans
- Diabetic control: severe  $\beta$ -cell degeneration

- Standard: marked recovery
- Extract 400 mg/kg: near-normal pancreatic architecture



### Discussion:

The present study demonstrated that *Mangifera indica* leaf extract possesses significant dose dependent antidiabetic activity in experimental diabetic rats, as evidenced by reduction in fasting blood glucose, improvement in body weight, normalization of lipid profile, reduction in HbA1c, restoration of

antioxidant enzymes, and histopathological protection of pancreatic  $\beta$ -cells. The 400 mg/kg dose showed better efficacy than 200 mg/kg, with effects approaching those of the standard drug glibenclamide. These findings suggest that the extract improves glycemic control and protects against diabetes-associated metabolic disturbances.

The improvement in body weight in treated animals indicates better utilization of glucose and reduced protein catabolism, which is a common consequence of uncontrolled diabetes. Similarly, the marked reduction in total cholesterol, triglycerides, and LDL along with increased HDL suggests that the extract effectively corrected diabetic dyslipidemia. A 2024 STZ-induced rat study also reported improved glycemic control, enhanced insulin secretion, and better cholesterol regulation after ethanolic *Mangifera indica* leaf extract treatment,

Overall, the results of the present study scientifically validate the traditional use of *Mangifera indica* leaves in diabetes management and indicate their potential as a safe, cost-effective herbal antidiabetic agent.

## Conclusion:

The present study concludes that *Mangifera indica* leaf extract possesses **significant dose dependent antidiabetic activity** in experimental diabetic rats. The extract effectively reduced fasting blood glucose levels, improved body weight, corrected lipid abnormalities, lowered HbA1c, restored antioxidant defence enzymes, and protected pancreatic  $\beta$ -cells from diabetic damage. The higher dose (**400 mg/kg**) showed superior activity and produced results comparable to the standard drug, indicating strong therapeutic potential. Further studies focusing on isolation of active phytoconstituents, molecular mechanisms, and clinical evaluation are required before therapeutic application.

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