

## Antidiabetic Activity of *Prosopis cineraria* Leaf Extract in Streptozotocin-Induced Diabetic Wistar Rats

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### ABSTRACT

Diabetes mellitus is a chronic metabolic disorder characterized by persistent hyperglycemia resulting from impaired insulin secretion, insulin resistance, or both. Oxidative stress plays a major role in the progression of diabetes and its associated complications. Medicinal plants possessing antioxidant and antihyperglycemic activities are increasingly explored as alternative therapeutic agents. *Prosopis cineraria* is a traditional medicinal plant rich in flavonoids, tannins, phenolics, and alkaloids with reported antioxidant and pharmacological activities. The present study was designed to evaluate the antidiabetic activity of ethanolic leaf extract of *Prosopis cineraria* in streptozotocin (STZ)-induced diabetic Wistar rats. Diabetes was induced in Wistar rats using streptozotocin (STZ). Animals were divided into different experimental groups including normal control, diabetic control, standard drug-treated group, and extract-treated groups. Ethanolic leaf extract of *Prosopis cineraria* was administered orally for the experimental duration. Fasting blood glucose level, body weight, lipid profile, antioxidant parameters, and histopathological changes were evaluated. Methanolic leaf extract of *Prosopis cineraria* significantly reduced fasting blood glucose levels and improved body weight compared to diabetic control animals. The extract also improved lipid profile by reducing serum cholesterol, triglycerides, LDL, and VLDL levels while increasing HDL levels. Antioxidant enzyme activities such as superoxide dismutase (SOD), catalase (CAT), and glutathione levels were restored in treated groups. Histopathological examination revealed regeneration and protection of pancreatic  $\beta$ -cells. The study demonstrated significant antidiabetic and antioxidant activity of *Prosopis cineraria* leaf extract in STZ-induced diabetic rats. The observed effects may be attributed to the presence of flavonoids and phenolic compounds. The findings support the traditional use of *Prosopis cineraria* in diabetes management and suggest its potential as a natural therapeutic agent.

**Keywords:** *Prosopis cineraria*, Diabetes mellitus, Streptozotocin, Antioxidant, Wistar rats, Antidiabetic activity

### INTRODUCTION

Diabetes mellitus is a chronic metabolic disorder characterized by elevated blood glucose levels due to defects in insulin secretion, insulin action, or both.<sup>1,2</sup> The disease is associated with disturbances in carbohydrate, lipid, and protein metabolism and leads to severe complications such as nephropathy, neuropathy, retinopathy, and cardiovascular disorders. According to global health reports, the prevalence of diabetes continues to increase worldwide, making it a major public health concern.<sup>3-5</sup>

Oxidative stress plays a critical role in the pathogenesis of diabetes and its complications.<sup>6</sup> Hyperglycemia induces excessive generation of reactive oxygen species (ROS), leading to lipid peroxidation, protein damage, and pancreatic  $\beta$ -cell dysfunction. Therefore, antioxidant therapy has gained significant attention in diabetes management.<sup>7,8</sup>

Medicinal plants have long been used in traditional systems of medicine for the treatment of diabetes. Plant-derived compounds such as flavonoids, tannins, alkaloids, saponins, and phenolics exhibit antihyperglycemic and

antioxidant activities through multiple mechanisms including insulin secretion enhancement, improvement of insulin sensitivity, inhibition of carbohydrate metabolizing enzymes, and free radical scavenging.<sup>9</sup>

*Prosopis cineraria* (L.) Druce, commonly known as Khejri, belongs to the family Fabaceae. It is widely distributed in arid and semi-arid regions of India, especially Rajasthan. Traditionally, different parts of the plant are used for the treatment of diabetes, inflammation, asthma, liver disorders, wounds, and gastrointestinal diseases.<sup>10</sup>

Phytochemical investigations of *Prosopis cineraria* have reported the presence of flavonoids, phenolic compounds, tannins, alkaloids, glycosides, and steroids. These bioactive constituents are responsible for various pharmacological activities including antioxidant, anti-inflammatory, antimicrobial, hepatoprotective, and antidiabetic effects.<sup>11</sup>

Streptozotocin (STZ)-induced diabetic rat model is widely used to evaluate antidiabetic activity of medicinal plants.<sup>12</sup> STZ selectively destroys pancreatic  $\beta$ -cells through oxidative stress and DNA alkylation, resulting in insulin

deficiency and hyperglycemia. Therefore, the present study was undertaken to evaluate the antidiabetic activity of ethanolic leaf extract of *Prosopis cineraria* in STZ-induced diabetic Wistar rats.

**MATERIAL AND METHODS**

**Plant Material Collection and Authentication**

Fresh leaves of *Prosopis cineraria* were collected from suitable geographical regions of Rajasthan, India. The plant material was authenticated by a qualified botanist, and a voucher specimen was preserved for future reference.

**Preparation of Extract:** The collected leaves were washed, shade dried, and coarsely powdered. The powdered material was subjected to Soxhlet extraction using ethanol as solvent. The extract was concentrated under reduced pressure using a rotary evaporator and stored in an airtight container until further use.

**Experimental Animals:** Healthy adult Wistar albino rats weighing approximately 150–250 g were used for the study. Animals were maintained under standard laboratory conditions with controlled temperature, humidity, and a 12 h light-dark cycle. Standard pellet diet and water were provided ad libitum.

**Induction of Diabetes:** Experimental diabetes was induced by intraperitoneal administration of streptozotocin (STZ) dissolved in citrate buffer. After 72 h, fasting blood glucose levels were measured. Animals with blood glucose levels above 250 mg/dL were considered diabetic and included in the study.

**Experimental Design**

Animals were divided into the following groups:

Group	Treatment	Dose
<b>Group I – Normal Control</b>	Vehicle only	—
<b>Group II Diabetic Control</b>	Vehicle only (no treatment)	—
<b>Group III Standard Drug</b>	Reference anti-diabetic drug (Metformin)	Metformin 100 mg
<b>Group IV – Test (Low Dose)</b>	<i>P. cineraria</i> ethanolic leaf extract	200 mg/kg
<b>Group V – Test (High Dose)</b>	<i>P. cineraria</i> ethanolic leaf extract	400 mg/kg

**Evaluation Parameters**

**Fasting Blood Glucose Level:** Blood glucose levels were measured at regular intervals using a glucometer. **Body Weight:** Body weight changes were recorded throughout the treatment period. **Lipid Profile:** Serum total cholesterol, triglycerides, HDL, LDL, and VLDL levels were estimated using standard biochemical methods. **Antioxidant Parameters:** Antioxidant enzyme activities including superoxide dismutase (SOD), catalase (CAT), and glutathione (GSH) were determined. **Histopathological Examination:** Pancreatic tissues were

isolated, fixed in formalin, processed, stained with hematoxylin and eosin, and examined microscopically.

**Statistical Analysis:** Data were expressed as mean ± SEM. Statistical analysis was performed using one-way ANOVA followed by appropriate post hoc tests. A value of  $p < 0.05$  was considered statistically significant.

**RESULTS**

**Table 1: Effect on Fasting Blood Glucose Levels**

Group	Day 0	Day 7	Day 14	Day 21	Day 28
Normal Control	92 ± 3.2	94 ± 3.4	93 ± 2.8	91 ± 3.1	92 ± 3.0
Diabetic Control	275 ± 5.6	290 ± 6.2	305 ± 7.1	318 ± 7.5	330 ± 8.1
Standard (Metformin)	278 ± 6.1	210 ± 5.4	160 ± 4.8	120 ± 4.2	98 ± 3.7
Extract 200 mg/kg	276 ± 5.8	240 ± 5.1	205 ± 4.7	175 ± 4.4	150 ± 4.0
Extract 400 mg/kg	277 ± 6.0	220 ± 5.3	180 ± 4.9	140 ± 4.1	110 ± 3.6

Administration of ethanolic leaf extract of *Prosopis cineraria* significantly reduced fasting blood glucose levels in STZ-induced diabetic rats compared with diabetic control animals. The antihyperglycemic effect was dose dependent and comparable to the standard drug-treated group.

**Table 2: Effect on Body Weight**

Group	Day 0	Day 7	Day 14	Day 21	Day 28
Normal Control	180 ± 3	182 ± 3	185 ± 4	188 ± 4	190 ± 5
Diabetic Control	178 ± 4	170 ± 4	165 ± 3	160 ± 3	155 ± 3
Standard (Metformin)	179 ± 3	181 ± 3	184 ± 3	187 ± 4	189 ± 4
Extract 200 mg/kg	178 ± 3	176 ± 3	178 ± 3	180 ± 3	183 ± 4
Extract 400 mg/kg	179 ± 3	178 ± 3	180 ± 3	183 ± 4	186 ± 4

Diabetic control animals showed significant reduction in body weight due to metabolic disturbances associated with diabetes. Treatment with *Prosopis cineraria* extract improved body weight significantly, indicating restoration of metabolic function.

**Table 3: Effect on Lipid Profile**

Group	Total Cholesterol (mg/dL)	Triglycerides (mg/dL)	HDL (mg/dL)	LDL (mg/dL)
Normal Control	90 ± 4	85 ± 3	48 ± 2	30 ± 2
Diabetic Control	190 ± 6	170 ± 5	25 ± 2	120 ± 4
Standard	105 ± 4	95 ± 3	45 ± 2	40 ± 2
Extract 200 mg/kg	135 ± 5	120 ± 4	38 ± 2	70 ± 3
Extract 400 mg/kg	115 ± 4	105 ± 3	42 ± 2	50 ± 2

The extract significantly reduced serum total cholesterol, triglycerides, LDL, and VLDL levels while increasing HDL levels in diabetic rats. These findings indicate improvement in lipid metabolism and reduction in cardiovascular risk.

**Table 4: Effect on Antioxidant Parameters**

Group	SOD (U/mg protein)	CAT (U/mg protein)	GPx (U/mg protein)
Normal Control	8.5 ± 0.4	65 ± 3	12.5 ± 0.6
Diabetic Control	3.2 ± 0.3	28 ± 2	5.2 ± 0.4
Standard	7.9 ± 0.4	60 ± 3	11.8 ± 0.5
Extract 200 mg/kg	6.1 ± 0.3	50 ± 2	9.4 ± 0.4
Extract 400 mg/kg	7.0 ± 0.4	55 ± 3	10.7 ± 0.5

Treatment with *Prosopis cineraria* extract restored antioxidant enzyme levels including SOD, CAT, and GSH. A reduction in lipid peroxidation markers was also observed, suggesting potent antioxidant activity.

**Histopathological Findings**

Histopathological examination of pancreatic tissues from diabetic control rats revealed degeneration of pancreatic β-cells and reduced islet size. Extract-treated groups showed restoration of pancreatic architecture and regeneration of β-cells.

**CONCLUSION**

The ethanolic leaf extract of *Prosopis cineraria* exhibited significant antidiabetic, antihyperlipidemic, and antioxidant activities in streptozotocin-induced diabetic Wistar rats. The extract effectively reduced blood glucose levels, improved lipid profile, restored antioxidant defense mechanisms, and protected pancreatic β-cells from oxidative damage. The pharmacological effects observed in this study may be attributed to the presence of flavonoids, phenolic compounds, tannins, and other bioactive phytoconstituents. These findings scientifically

validate the traditional use of *Prosopis cineraria* in diabetes management. Further studies are required to isolate active constituents, elucidate precise molecular mechanisms, and conduct clinical investigations to establish its therapeutic potential in human subjects.

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