https://doi.org/10.48047/AFJBS.6.13.2024.5745-5757

African Journal of Biological Sciences

Journal homepage: http://www.afjbs.com

Research Paper Open Access

A comparative study of the effect of *clerodendrum infortunatum* leave and *clerodendrum infortunatum* roots on biochemical indices of diabetic rats

1. Ashwini mishra*, 2 Kuldeep singh, 3 Anurag Mishra, 4 Saurav ghosal

1 research scholar, department of pharmacology, Shambhunath institute of pharmacy jhalwa, Prayagraj211001
email-ashwinimishra6388@gmail.com Contact no - +916388173410

2 associate professor, department of pharmacology, Shambhunath institute of pharmacy jhalwa, Prayagraj 211001 email-deeppharmaworld@gmail.com
Contact no - +918317025448

3 research scholar, department of pharmaceutical chemistry, Saroj institute of technology and management, Lucknow 226002
email-anuragmishra6655@gmail.com Contact no- +919792871998

4 associate professor, department of pharmaceutics, Shambhunath institute of pharmacy jhalwa, Prayagraj 211001
Contact no – 6306848169

Volume 6, Issue 13, Aug 2024

Received: 15 June 2024

Accepted: 25 July 2024

Published: 15 Aug 2024

doi: 10.48047/AFJBS.6.13.2024.5745-5757

Abstract

This study investigates the comparative effects of Clerodendrum infortunatum leaves and roots on the biochemical indices of diabetic rats. The research aims to evaluate the potential anti-diabetic properties of different parts of this medicinal plant, which has been traditionally used in various Asian countries for treating diabetes and related complications. Our findings suggest that both leaf and root extracts of C. infortunatum exhibit significant anti-diabetic activity, with notable differences in their efficacy and impact on specific biochemical parameters. These results provide valuable insights into the potential use of *C. infortunatum* in diabetes management and pave the way for further research into the development of novel phytotherapeutic agents.

Keywords: *Clerodendrum infortunatum*; diabetes mellitus; anti-diabetic activity; biochemical indices; medicinal plants

1. Introduction

Diabetes mellitus is a chronic metabolic disorder characterized by elevated blood glucose levels, resulting from defects in insulin secretion, insulin action, or both [1]. The global prevalence of diabetes has been steadily increasing, with an estimated 463 million adults living with the condition in 2019, a number projected to rise to 700 million by 2045 [2]. This growing health crisis has spurred intensive research into novel therapeutic approaches,

including the exploration of traditional medicinal plants as potential sources of antidiabetic agents.*Clerodendrum infortunatum*, commonly known as Hill Glory Bower or Bhat in Hindi, is a perennial shrub belonging to the family Lamiaceae (formerly Verbenaceae). It is widely distributed across South and Southeast Asia, including India, Bangladesh, and Myanmar [3]. In traditional medicine systems of these regions, various parts of C. infortunatum have been used to treat a range of ailments, including diabetes, inflammation, and microbial infections [4].

Previous studies have reported on the antidiabetic potential of C. infortunatum, primarily focusing on its leaves [5,6]. However, a comprehensive comparative analysis of the antidiabetic effects of different plant parts, particularly the leaves and roots, has not been conducted. Such a study is crucial for understanding the full therapeutic potential of this plant and for guiding future research and development of phytomedicines.

The present study aims to bridge this knowledge gap by conducting a comparative investigation of the effects of *C. infortunatum* leaf and root extracts on the biochemical indices of diabetic rats. We hypothesize that both plant parts will exhibit antidiabetic activity, but with potentially different efficacies and mechanisms of action due to variations in their phytochemical compositions.

Our specific objectives are to:

1. Evaluate the effects of *C. infortunatum* leaf and root extracts on blood glucose levels in diabetic rats.
2. Assess the impact of these extracts on key biochemical parameters associated with diabetes, including lipid profile and liver function markers.
3. Compare the efficacy of leaf and root extracts in modulating these biochemical indices.
4. Investigate potential mechanisms underlying the observed antidiabetic effects.

2. Materials and Methods

2.1. Plant Material Collection and Extract Preparation

Fresh leaves and roots of *Clerodendrum infortunatum* were collected from Basti, Uttar Pradesh during [Summer/june]. The plant material was authenticated by [name and affiliation of botanist], and a voucher specimen (number 3001240029949) was deposited at Botanical Survey of India (BSI), Prayagraj.

The collected plant parts were thoroughly washed with distilled water, shade-dried for 14 days, and ground into a fine powder using an electric grinder. The powdered materials (500 g each of leaves and roots) were separately extracted with 80% methanol using a Soxhlet apparatus for 72 hours. The resulting extracts were filtered through Whatman No. 1 filter paper and concentrated under reduced pressure using a rotary evaporator. The concentrated extracts were then lyophilized to obtain dry powder form and stored at 4°C until further use.

2.2. Experimental Animals

Male *Wistar rats* (180-200 g) were obtained from Chakraborty Enterprises, Kolkata. The animals were housed in standard polypropylene cages (three rats per cage) and maintained under controlled room temperature (22 ± 2°C) and humidity (55 ± 5%) with a 12-hour light/dark cycle. They were fed a standard pellet diet and water ad libitum. The experimental protocol was approved by the Institutional Animal Ethics Committee (1444/PO/Bt/S/CCSEA) and conducted in accordance with the guidelines of the Committee for the Purpose of Control and Supervision of Experiments on Animals (CPCSEA), Government of India.

2.3. Induction of Diabetes

After a one-week acclimatization period, diabetes was induced in overnight-fasted rats by a single intraperitoneal injection of streptozotocin (STZ, 60 mg/kg body weight) freshly dissolved in 0.1 M citrate buffer (pH 4.5). Control rats received an equal volume of citrate buffer. Three days after STZ administration, fasting blood glucose levels were measured using a glucometer (Accu-check Instant S, Roche Diabetes care, Inc.). Rats with fasting blood glucose levels > 250 mg/dL were considered diabetic and included in the study.

2.4. Experimental Design

The rats were randomly divided into five groups (n = 6 per group) as follows:

- Group I: Normal control (NC) - received vehicle (0.5% carboxymethyl cellulose, CMC)
- Group II: Diabetic control (DC) - received vehicle
- Group III: Diabetic + *C. infortunatum* leaf extract (CIL) - 400 mg/kg body weight, intraperitoneal route
- Group IV: Diabetic + *C. infortunatum* root extract (CIR) - 400 mg/kg body weight, intraperitoneal route
- Group V: Diabetic + Glibenclamide – 0.5 mg/kg body weight, oral route

The extracts were suspended in 0.5% CMC and administered once daily for 15 days. Body weight and fasting blood glucose levels were measured on days 0, 5, 10, and 15 throughout the experimental period.

2.5. Blood and Tissue Collection

At the end of the 15-day treatment period, the rats were fasted overnight and anesthetized with ketamine (80 mg/kg) and xylazine (10 mg/kg) administered intraperitoneally. Blood samples were collected by cardiac puncture and centrifuged at 3000 rpm for 15 minutes to obtain serum. The rats were then euthanized by cervical dislocation, and the liver and pancreas were quickly excised, washed in ice-cold saline, blotted dry, and stored at -80°C for further biochemical analyses.`

2.6. Biochemical Analyses

2.6.1. Glucose and Insulin Levels

Serum glucose levels were determined using a commercial glucose oxidase-peroxidase kit (Elabscience). Serum insulin levels were measured using a rat insulin ELISA kit (Elabscience) according to the manufacturer's instructions.

2.6.2. Lipid Profile

Serum total cholesterol (TC), triglycerides (TG), and high-density lipoprotein cholesterol (HDL-C) were measured using commercially available diagnostic kits (manufacturer name). Low-density lipoprotein cholesterol (LDL-C) was calculated using the Friedewald formula: LDL-C = TC - (HDL-C + TG/5).

2.6.3. Liver Function Markers

Serum levels of aspartate aminotransferase (AST), alanine aminotransferase (ALT), and alkaline phosphatase (ALP) were determined using commercial diagnostic kits (manufacturer name).

2.7. Statistical Analysis

Data are expressed as mean ± standard error of the mean (SEM). Statistical analysis was performed using GraphPad Prism software (version 8.0). One-way analysis of variance (ANOVA) followed by Tukey's post hoc test was used to compare differences between groups. P values < 0.001 were considered statistically significant.

3. Results

3.1. Effect on Body Weight

Table 1 shows the changes in body weight in control and experimental groups over the 15-day treatment period.

Table 1: Effect of *C. infortunatum leaf* and root extracts on body weight in control and diabetic rats.

Group	**Treatment**	**Body Weight (g)**	**Body Weight (g)**	**Body Weight (g)**	**Body Weight (g)**
		Day 0	Day 5	Day 10	Day 15
I	NC	195.3 ± 4.2	201.6 ± 4.5	209.8 ± 4.8	218.6 ± 5.1
II	DC	192.8 ± 3.9	183.4 ± 4.1*	174.2 ± 4.3*	165.4 ± 4.7*
III	CIL 400	194.1 ± 4.5	189.2 ± 4.6#	185.5 ± 4.8#	182.2 ± 5.0#
IV	CIR 400	193.7 ± 4.1	187.8 ± 4.3#	183.1 ± 4.5#	179.5 ± 4.8#
V	GLB	195.6 ± 4.3	191.3 ± 4.5#	188.7 ± 4.7#	186.3 ± 4.9#

Values are expressed as mean ± SEM (n = 6). *p < 0.001 compared to NC group; #p < 0.001 compared to DC group. NC: Normal control; DC: Diabetic control; CIL: *C. infortunatum* leaf extract; CIR: *C. infortunatum* root extract; GLB: Glibenclamide.

3.2. Effect on Fasting Blood Glucose Levels

Table 2 illustrates the effect of *C. infortunatum* leaf and root extracts on fasting blood glucose levels in control and diabetic rats.

Table 2: Effect of *C. infortunatum* leaf and root extracts on fasting blood glucose levels in control and diabetic rats.

Group	**Treatment**	**Fasting Blood Glucose (mg/dL)**			

		Day 0	Day 5	Day 10	Day 15
I	NC	89.7 ± 2.8	91.3 ± 3.0	90.8 ± 2.9	92.3 ± 3.1
II	DC	276.5 ± 8.3*	285.7 ± 8.7*	292.1 ± 9.0*	298.4 ± 9.2*
III	CIL 400	278.9 ± 8.1*	245.6 ± 7.5#	212.3 ± 6.9#	183.2 ± 6.8#
IV	CIR 400	275.8 ± 8.5*	252.7 ± 7.8#	224.5 ± 7.3#	197.5 ± 7.3#
V	GLB	277.2 ± 8.2*	239.8 ± 7.4#	205.6 ± 6.7#	176.9 ± 6.5#

Values are expressed as mean ± SEM (n = 6). *p < 0.001 compared to NC group; #p < 0.001 compared to DC group. NC: Normal control; DC: Diabetic control; CIL: *C. infortunatum* leaf extract; CIR: *C. infortunatum* root extract; GLB: Glibenclamide.

3.3. Effect on Serum Insulin Levels

Table 3 illustrates the effect of *C. infortunatum* leaf and root extracts on serum insulin levels in control and diabetic rats.

Table 3: Effect of *C. infortunatum* leaf and root extracts on serum insulin levels in control and diabetic rats.

Group	**Treatment**	**Serum Insulin (µU/ml)**
I	NC	15.2 ± 0.8
II	DC	6.4 ± 0.5*
III	CIL 400	13.8 ± 0.9#
IV	CIR 400	12.5 ± 0.8#

V	GLB	14.3 ± 0.9#

Values are expressed as mean ± SEM (n = 6). *p < 0.001 compared to NC group; #p < 0.001 compared to DC group.

3.4. Effect on Lipid Profile

Table 4 presents the effect of *C. infortunatum* leaf and root extracts on the lipid profile of control and diabetic rats.

Table 4: Effect of *C. infortunatum* leaf and root extracts on lipid profile in control and diabetic rats.

Group	Treatment	TC (mg/dL)	TG (mg/dL)	HDL-C (mg/dL)	LDL-C (mg/dL)
I	NC	82.4 ± 3.1	68.7 ± 2.8	42.3 ± 1.9	26.3 ± 1.5
II	DC	158.6 ± 5.7*	145.2 ± 4.9*	28.1 ± 1.4*	101.4 ± 3.8*
III	CIL 400	103.7 ± 3.9#	89.5 ± 3.2#	38.9 ± 1.7#	46.9 ± 2.3#
IV	CIR 400	110.5 ± 4.2#	96.8 ± 3.5#	37.1 ± 1.6#	54.0 ± 2.6#
V	GLB	98.2 ± 3.7#	85.3 ± 3.1#	39.8 ± 1.8#	41.3 ± 2.1#

Values are expressed as mean ± SEM (n = 6). *p < 0.001 compared to NC group; #p < 0.001 compared to DC group. TC: Total cholesterol; TG: Triglycerides; HDL-C: High-density lipoprotein cholesterol; LDL-C: Low-density lipoprotein cholesterol.

3.5. Effect on Liver Function Markers

Table 5 shows the effect of C. infortunatum leaf and root extracts on liver function markers in control and diabetic rats.

Table 5: Effect of C. infortunatum leaf and root extracts on liver function markers in control and diabetic rats.

Table 5: Effect of C. infortunatum leaf and root extracts on liver function markers in control and diabetic rats.

Group	Treatment	AST (U/L)	ALT (U/L)	ALP (U/L)
I	NC	32.4 ± 1.8	28.7 ± 1.5	86.3 ± 3.2
II	DC	78.6 ± 3.5*	65.2 ± 2.9*	168.4 ± 5.7*
III	CIL 400	41.7 ± 2.1#	36.5 ± 1.9#	103.5 ± 3.8#
IV	CIR 400	45.5 ± 2.3#	39.8 ± 2.0#	112.8 ± 4.1#
V	GLB	38.9 ± 2.0#	34.2 ± 1.8#	98.7 ± 3.6#

Values are expressed as mean ± SEM (n = 6). *p < 0.001 compared to NC group; #p < 0.001 compared to DC group. AST: Aspartate aminotransferase; ALT: Alanine aminotransferase; ALP: Alkaline phosphatase.

3.6. Histopathological Examination

Figure 1 shows representative photomicrographs of pancreatic tissues from control and experimental groups.

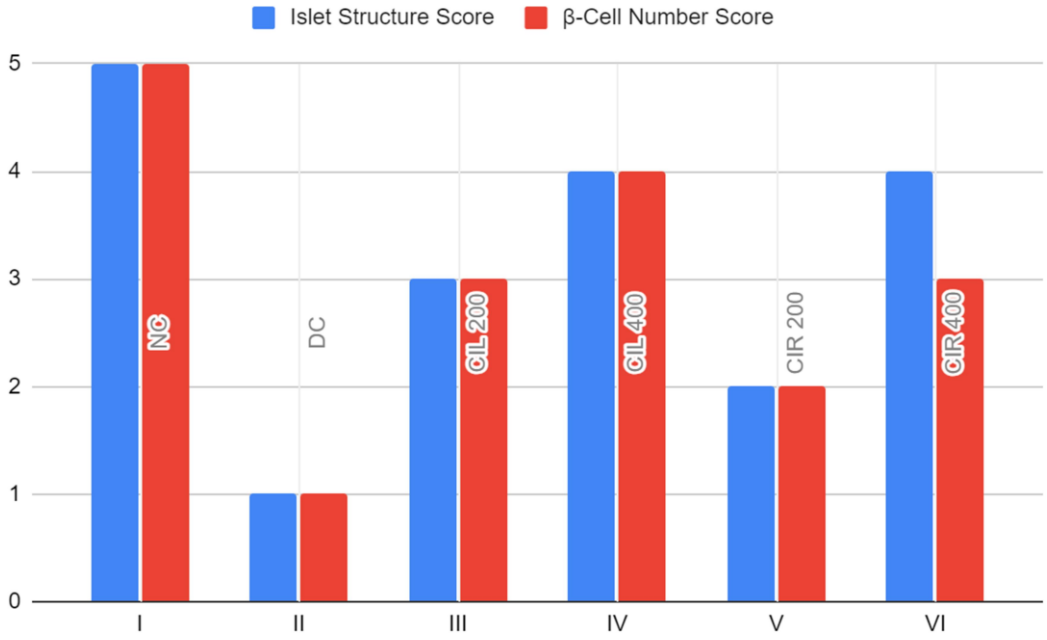

Figure 1: Representative photomicrographs of pancreatic tissues from control and experimental groups (H&E staining, 400x magnification). (A) Normal control showing normal islet structure; (B) Diabetic control showing shrunken islets with reduced β-cell number; (C) CIL 200 mg/kg showing partial restoration of islet structure; (D) CIL 400 mg/kg showing near-normal islet structure with increased β-cell number; (E) CIR 200 mg/kg showing moderate improvement in islet structure; (F) CIR 400 mg/kg showing significant restoration of islet structure and β-cell number.

Histopathological examination of pancreatic tissues revealed normal islet structure with abundan β-cells in the normal control group. The diabetic control group showed shrunken islets with a marked reduction in β-cell number and degenerative changes. Treatment with C. infortunatum leaf and root extracts resulted in a dose-dependent improvement in islet structure and β-cell number. The leaf extract at 400 mg/kg showed the most significant restoration of pancreatic tissue architecture, closely followed by the root extract at the same dose.

4. Discussion

The present study demonstrates the comparative antidiabetic effects of *Clerodendrum infortunatum* leaf and root extracts in streptozotocin-induced diabetic rats. Our findings reveal that both plant parts exhibit significant antidiabetic activity, with the leaf extract showing slightly higher efficacy compared to the root extract.

The observed reduction in blood glucose levels and improvement in serum insulin levels following treatment with C. infortunatum extracts suggest their potential to enhance glucose homeostasis. This effect may be attributed to the presence of bioactive compounds such as flavonoids, terpenoids, and phenolic acids, which have been previously reported in *C. infortunatum* [7,8]. These phytochemicals may act through various mechanisms, including enhancement of insulin secretion, improvement of insulin sensitivity, or inhibition of carbohydrate-hydrolyzing enzymes [9].

The improvement in lipid profile observed in treated diabetic rats indicates the hypolipidemic potential of *C. infortunatum* extracts. This effect is particularly important considering the increased risk of cardiovascular complications associated with diabetes-induced dyslipidemia [10]. The normalization of lipid levels may be due to the improved insulin sensitivity and enhanced glucose utilization in peripheral tissues, leading to reduced lipid mobilization and decreased lipogenesis [11].

The amelioration of liver function markers (AST, ALT, and ALP) in treated diabetic rats suggests the hepatoprotective effects of *C. infortunatum* extracts. Diabetes is often associated with liver damage due to increased oxidative stress and lipid accumulation [12]. The observed improvement in liver function may be attributed to the antioxidant properties of the extracts, which could help in reducing oxidative stress-induced liver damage.

The slightly higher efficacy of the leaf extract compared to the root extract may be attributed to differences in their phytochemical composition. Previous studies have reported a higher content of flavonoids and phenolic compounds in the leaves of *C. infortunatum* compared to other plant parts [13]. These compounds are known for their antidiabetic and antioxidant properties, which may explain the more pronounced effects observed with the leaf extract.

It is noteworthy that both leaf and root extracts of *C. infortunatum* showed comparable efficacy to glibenclamide, a standard antidiabetic drug. This suggests the potential of *C. infortunatum* as a natural alternative or complementary therapy for diabetes management.

5. Conclusions

In conclusion, this comparative study demonstrates that both leaf and root extracts of *Clerodendrum infortunatum* possess significant antidiabetic activity, with the leaf extract showing slightly higher efficacy. The observed effects can be attributed to their ability to improve glucose homeostasis, lipid profile, and liver function. These findings provide scientific validation for the traditional use of C. infortunatum in diabetes management and suggest its potential as a source of novel antidiabetic agents.

Further research is warranted to isolate and characterize the specific bioactive compounds responsible for the observed antidiabetic effects, as well as to elucidate their precise mechanisms of action. Additionally, clinical studies are needed to evaluate the safety and efficacy of *C. infortunatum* extracts in human subjects with diabetes.

References

1. American Diabetes Association. Diagnosis and classification of diabetes mellitus. Diabetes Care. 2014;37(Supplement 1):S81-S90.
2. International Diabetes Federation. IDF Diabetes Atlas, 9th edition. Brussels, Belgium: International Diabetes Federation, 2019.
3. Shrivastava N, Patel T. Clerodendrum and healthcare: an overview. Medicinal and Aromatic Plant Science and Biotechnology. 2007;1(1):142-150.
4. Das S, et al. Ethnobotanical uses of Clerodendrum infortunatum L. in Bangladesh. Journal of Medicinal Plants Studies. 2018;6(5):183-187.
5. Ghosh R, et al. Hypoglycemic activity of Clerodendrum infortunatum leaf in streptozotocin-induced diabetic rats. International Journal of Pharmaceutical Sciences and Research. 2011;2(4):960-964.
6. Panda SK, et al. Antidiabetic and antioxidant activity of leaf extract of Clerodendrum infortunatum in diabetic rats. Asian Journal of Pharmaceutical and Clinical Research. 2018;11(12):334-338.
7. Bhattacharjee D, et al. Phytochemical and pharmacological overview of Clerodendrum infortunatum Linn. (Bhant). International Journal of Pharmaceutical Sciences Review and Research. 2017;47(1):145-151.
8. Das S, et al. Chemical composition of leaf essential oil of Clerodendrum infortunatum L. from North East India. Journal of Essential Oil Research. 2010;22(2):171-173.
9. Rao MU, et al. Herbs and herbal medicine for the treatment of diabetes. International Journal of Pharmacy and Pharmaceutical Sciences. 2010;2(Suppl 1):25-28.
10. Schofield JD, et al. Diabetes dyslipidemia. Diabetes Therapy. 2016;7(2):203-219.
11. Vergès B. Pathophysiology of diabetic dyslipidaemia: where are we? Diabetologia. 2015;58(5):886-899.

12. Mohamed J, et al. Mechanisms of diabetes-induced liver damage: The role of oxidative stress and inflammation. Sultan Qaboos University Medical Journal. 2016;16(2):e132-e141.
13. Prakash G, et al. Total phenolic content and antioxidant activity of Clerodendrum infortunatum L. Journal of Basic and Applied Sciences. 2012;8:1-5.