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Research Article

Antidiabetic Effect of *Coffea arabica* Stem Extract in Alloxan-Induced Diabetic Rats

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Abstract

Background: Diabetes mellitus is a chronic metabolic disorder characterized by persistent hyperglycemia resulting from defects in insulin secretion, insulin action, or both, andremains a significant global health challenge affecting over 500 million people worldwide. Conventional antidiabetic therapies, though clinically effective, are often limited by high cost, side effects, and long-term organ toxicity, necessitating the search for safer plant-based alternatives. **Aim:** To evaluate the antidiabetic potential of *Coffea arabica* stem extract in alloxan-induced diabetic rats. **Method:** 25 healthy male Wistar rats (150–200 g) were divided into five groups (n = 5): normal control, diabetic control, diabetic + extract (200 mg/kg), diabetic + extract (400 mg/kg), and diabetic + glibenclamide (5 mg/kg). Diabetes was induced by intraperitoneal injection of alloxan monohydrate (150 mg/kg body weight). Fasting blood glucose (FBG) levels and body weight were measured on Days 0, 7, and 14. **Results:** Treatment with the extract produced a significant, dose-dependent reduction in FBG levels. By Day14, the 400 mg/kg group showed approximately 61% reduction in blood glucose, comparable to the glibenclamide group($\sim$ 64%). Treated rats also showed progressive improvement in body weight compared to diabetic controls. **Conclusion:** These findings indicate that *Coffea arabica* stem extract exerts significant antihyperglycemic effects, supporting its potential as a natural therapeutic agent for diabetes management.

1. Introduction

Diabetes mellitus is a chronic metabolic disorder characterized by persistent hyperglycemia resulting from defects in insulin secretion, insulin action, or both. It is a major global health issue with increasing prevalence, leading to serious complications including cardiovascular diseases, neuropathy, nephropathy, and retinopathy [1]. The condition affects over 500 million people worldwide, with projections indicating a sharp increase in prevalence over the next decades [2].

Conventional treatment approaches involve the use of oral hypoglycemic agents or insulin therapy, which may be effective but are often accompanied by adverse effects such as hypoglycemia, weight gain, and gastrointestinal discomfort [3]. These drawbacks have prompted a renewed interest in safer, more affordable alternatives derived from natural sources. Many researchers are turning their attention toward medicinal plants, which have historically served as a valuable source of bioactive compounds for managing chronic diseases [4].

Coffea arabica, commonly known as *Arabica coffee*, is widely cultivated for its beans used in beverage production. Bioactive compounds present in various parts of the coffee plant have been reported to possess antioxidant, anti-inflammatory, and antidiabetic properties [5, 6].

While much of the focus has been on coffee beans and leaves, the stem of *Coffea arabica* remains largely underexplored, despite preliminary evidence suggesting it may contain biologically active compounds with antioxidant and hypoglycemic properties.

Animal models, such as alloxan-induced diabetic rats, offer a reliable platform to investigate the antidiabetic efficacy of natural products. Alloxan selectively destroys pancreatic β-cells, mimicking Type 1 diabetes pathology by inducing insulin deficiency and subsequent hyperglycemia [7]. This study therefore investigates the antidiabetic effect of *Coffea arabica* stem extract in alloxan-induced diabetic rats, with the aim of identifying novel plant-based interventions that could complement or serve as alternatives to conventional antidiabetic therapies.

2. Methods

2.1. Study Area

The study was carried out in the Department of Genetics and Biotechnology Laboratory, University of Calabar. Experimental animals were obtained from the Animal House of the Department of Zoology and Environmental Biology, University of Calabar, Cross-River State, Nigeria.

2.2. Collection and Preparation of Plant Material

Coffea arabica stems were collected from a local market, authenticated at the Department of Botany, University of Calabar,and air-dried for 7–10 days. The dried stems were pulverized into fine powder and extracted using 80% methanol in a Soxhlet apparatus for 6 hours. The extract was concentrated using a rotary evaporator and stored at 4°C until use.

2.3. Experimental Animals

Twenty-five healthy male *Wistar rats* weighing 150–200 g were obtained and housed under standard laboratory conditions. Animals were allowed to acclimatize for one week with free access to food and water ad libitum.

2.4. Induction of Diabetes

Diabetes was induced by intraperitoneal injection of alloxan monohydrate (150 mg/kg body weight) dissolved in normal saline after 12 hours of fasting. Blood glucose levels were measured 72 hours post-induction using a glucometer. Rats with fasting blood glucose levels above 200 mg/dL were considered diabetic and used for the study.

2.5. Experimental Design

The diabetic rats were divided into five groups (n = 5 per group) as follows: Group I: Normal control (distilled water); Group II: Diabetic control (alloxan only); Group III: Diabetic + *Coffea arabica* extract (200 mg/kg); Group IV: Diabetic + *Coffea arabica* extract (400 mg/kg), and Group V: Diabetic + standard drug (glibenclamide, 5 mg/kg). Extracts were administered orally once daily for 14 days.

2.6. Monitoring Parameters

Fasting blood glucose levels were measured on Days 0, 7, and 14 using tail vein blood samples collected with a glucometer. Body weight was recorded weekly.

2.7. Statistical Analysis

Data are expressed as mean ± standard deviation (SD). One-way analysis of variance (ANOVA) was used to compare means across groups. A significance level of $p < 0.05$ was considered statistically significant.

3. Results

3.1. Induction of Diabetes and Blood Glucose Levels

Table 1 shows Alloxan administration (150 mg/kg) which produced FBG levels exceeding 200 mg/dL in all diabetic rats. Diabetic control rats maintained persistently elevated FBG across the 14-day period (291.2 ± 9.4 mg/dL on Day 14). The 200 mg/kg and 400 mg/kg extract-treated groups recorded mean FBG of 153.3 ± 6.3 mg/dL and 121.5 ± 5.1 mg/dL, respectively, by Day 14, compared to 110.4 ± 4.8 mg/dL in the glibenclamide group ($p < 0.05$ vs diabetic control). Normal control rats maintained stable FBG levels throughout (90.1 ± 4.1 mg/dL on Day 14).

Table 1: Effect of *Coffea arabica* Stem Extract on Fasting Blood Glucose Levels (mg/dL)

Group	Day 0	Day 7	Day 14
Normal Control	89.6 ± 4.3	92.2 ± 3.7	90.1 ± 4.1
Diabetic Control	304.4 ± 6.5	298.6 ± 8.1	291.2 ± 9.4
Diabetic + Extract (200 mg/kg)	312.1 ± 5.7	221.4 ± 7.8	153.3 ± 6.3
Diabetic + .Extract (400 mg/kg)	310.2 ± 6.9	191.7 ± 5.9	121.5 ± 5.1
Diabetic + Glibenclamide 5mg/kg)	308.5 ± 7.2	177.3 ± 6.6	110.4 ± 4.8

Values are expressed as mean ± SD, n = 5 rats/group.
$p < 0.05$, $p < 0.01$, $p < 0.001$ vs diabetic control.

3.2. Body Weight Changes

Normal control rats maintained steady weight gain across the study period, while diabetic control rats exhibited progressive weight loss, consistent with uncontrolled hyperglycemia.Treatment with the extract produced dose-dependent weight recovery; the 200 mg/kg group showed partial restoration, reflecting partial metabolic correction. The 400 mg/kg group nearly matched the glibenclamide group by Day 14, indicating that *Coffea arabica* stem extract mitigates diabetes-associated body weight loss alongside its antihyperglycemic effects. These findings are presented in Table 2 below.

Table 2: Effect of *Coffea arabica* Stem Extract on Body Weight(g)

Group	Day 0	Day 7	Day 14
Normal Control	182.2 ± 5.6	188.3 ± 6.2	193.5 ± 5.8
Diabetic Control	180.5 ± 4.9	170.3 ± 5.4	160.1 ± 4.6
Diabetic + Extract (200 mg/kg)	179.8 ± 6.1	182.6 ± 5.7	185.4 ± 6.3
Diabetic + Extract (400 mg/kg)	180.2 ± 5.8	185.9 ± 6.2	190.6 ± 5.1
Diabetic + Glibenclamide	181.7 ± 5.2	186.3 ± 5.6	191.7 ± 4.9

Values are expressed as mean ± SD, n = 5 rats/group.

4. Discussion

The results of this study demonstrate that *Coffea arabica* stem extract possesses significant antihyperglycemic activity in alloxan-induced diabetic rats. Alloxan selectively destroys pancreatic β-cells via redox cycling and generation of reactive oxygen species, resulting in insulin deficiency and hyperglycemia [7, 8]. The successful induction of diabetes was confirmed by FBG levels exceeding 200 mg/dL in alloxan-treated rats.

The dose-dependent reduction in blood glucose observed in extract-treated groups is consistent with the bioactive compound profile reported for coffee plant parts. Chlorogenic acid and other polyphenols found in various parts of the coffee plant have been shown to modulate glucose metabolism by improving insulin sensitivity and inhibiting intestinal glucose absorption [9]. Flavonoids such as quercetin and kaempferol can scavenge free radicals, thereby protecting pancreatic β-cells from oxidative damage [10]. Tannins and saponins may also contribute to glucose lowering by inhibiting carbohydrate-digesting enzymes [11].

The improvement in body weight observed in extract-treated groups is significant, as progressive weight loss is a classic feature of uncontrolled diabetes resulting from the catabolic breakdown of proteins and fats in the absence of adequate insulin activity [12]. The near-complete restoration of body weight in the 400 mg/kg group, comparable to the glibenclamide group, further supports the efficacy of the extract in correcting the metabolic disturbances induced by alloxan.

These findings collectively support the rationale for investigating *Coffea arabica* stem as a source of novel antidiabetic compounds. The stem, being a largely underutilized agricultural byproduct, offers the additional advantage of being cost-effective and potentially accessible for populations in low- and middle-income countries where the burden of diabetes is growing rapidly.

5. Conclusion

Coffea arabica stem extract significantly reduced hyperglycemia and improved body weight in alloxan-induced diabetic rats in a dose-dependent manner. The 400 mg/kg dose achieved efficacy comparable to the standard drug glibenclamide. These findings indicate the therapeutic promise of *Coffea arabica* stem as a natural agent for diabetes management. Further studies including isolation of active compounds, toxicity profiling, dose optimization, and clinical trials are recommended to confirm efficacy and safety for pharmaceutical development.

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References

[1] *Standards of medical care in diabetes 2022*, volume 45. American Diabetes Association, 2022. URL https://doi.org/10.2337/dc22-s001. Pages S1-S264.

[2] *IDF Diabetes Atlas*. International Diabetes Federation, Brussels, 10^{th} edition, 2021. URL https://diabetesatlas.org.

[3] N. M. Maruthur, E. Tseng, S. Hutfless, L. M. Wilson, C. Suarez-Cuervo, Z. Berger, Y. Chu, E. Iyoha, J. B. Segal, and S. Bolen. Diabetes medications as monotherapy or metformin-based combination therapy for type 2 diabetes. *Ann Intern Med*, 164(11):740–751, 2016. URL https://doi.org/10.7326/m15-2650.

[4] D. K. Patel, S. K. Prasad, R. Kumar, and S. Hemalatha. An overview on antidiabetic medicinal plants having insulin mimetic property. *Asian Pac J Trop Biomed*, 2(4):320–330, 2012. URL https://doi.org/10.1016/s2221-1691(12)60032-x.

[5] M. Daglia, A. Papetti, C. Gregotti, F. Berte, and G. Gazzani. In vitro antioxidant and ex vivo protective activities of green and roasted coffee. *J Agric Food Chem*, 48(5):1449–1454, 2000. URL https://doi.org/10.1021/jf990510g.

[6] H. Ashihara and A. Crozier. Caffeine: A well-known but little-mentioned compound in plant science. *Trends Plant Sci.*, 6(9):407–413, 2001. URL https://doi.org/10.1016/s1360-1385(01)02055-6.

[7] T. Szkudelski. The mechanism of alloxan and streptozotocin action in β-cells of the rat pancreas. *Physiol Res*, 50(6):537–546, 2001.

[8] S. Lenzen. The mechanisms of alloxan- and streptozotocin-induced diabetes. *Diabetologia*, 51(2):216–226, 2008. URL https://doi.org/10.1007/s00125-007-0886-7.

[9] K. L. Johnston, M. N. Clifford, and L. M. Morgan. Coffee acutely modifies gastrointestinal hormone secretion and glucose tolerance in humans. *Am J Clin Nutr*, 78(4):728–733, 2003. URL https://doi.org/10.1093/ajcn/78.4.728.

[10] M. Farhan, A. Rizvi, I. Naseem, and S. Haneef. Evaluation of antidiabetic and antioxidant activity of some medicinal plants: A comparative study. *Asian Pac J Trop Biomed*, 9(5):212–218, 2019. URL https://doi:10.4103/2221-1691.258005.

[11] M. Ahmed, M. Aslam, M. Saeed, and M. Shoaib. Medicinal potential of Coffea arabica plant: A review. *J Pharmacogn Phytochem*, 9 (3):1157–1162, 2020.

[12] A. T. Kharroubi and H. M. Darwish. Diabetes mellitus: The epidemic of the century. *World J Diabetes*, 6(6):850–867, 2015.