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The effect of the aqueous and alcoholic extracts of *Tamarindus indica* in suppressing hyperglycaemia in alloxan-induced diabetic rats

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ABSTRACT

This study has investigated the antihyperglycaemic effects of aqueous and alcoholic extracts of *Tamarindus indica* (*T. indica*) in adult male Sprague Dawley rats with alloxan-induced diabetes. Forty-nine rats (mean body weight: 230 ± 20 g) were randomly assigned to seven groups (n=7 per group): group 1 comprised healthy control rats, group 2 included diabetic control rats, groups 3 and 4 included diabetic rats that received 500 mg/kg of aqueous or alcoholic *T. indica* extract (orally, *via* gavage), groups 5 and 6 included non-diabetic (normal) rats that received the same doses of aqueous or alcoholic *T. indica* extract as the previous two groups; and group 7 included diabetic rats that were treated subcutaneously with insulin (6 IU/kg body weight). Diabetic rats (group 2) exhibited a significant elevation in blood glucose levels ($p<0.05$), whereas all treatments with *T. indica* extracts (groups 3–6) resulted in a statistically significant reduction ($p<0.05$) of the rat blood glucose levels, with the alcoholic extract demonstrating the most pronounced effect. These findings provide evidence of the antihyperglycaemic activity of *T. indica*, the extracts of which possess potent antioxidant properties and may offer therapeutic benefit in the management of diabetes.

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1. Introduction

Plants offer considerable potential as alternative therapies for blood glucose regulation due to their accessibility, cost-effectiveness, efficacy, and safety. They produce secondary metabolites (such as terpenoids, flavonoids, alkaloids, tannins, and ferulic acid) that exhibit glucose-lowering properties[1]. Moreover, herbal remedies are gen-

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erally more affordable, safer, and associated with fewer adverse effects than synthetic pharmaceuticals. It has been proposed that using the whole plant enhances synergistic effects, as the constituent compounds interact to yield more beneficial outcomes. Herbalists argue that this synergy among plant components may also mitigate toxicity[2].

Each plant species possesses a distinct profile of bioactive compounds, offering unique nutritional and therapeutic benefits. A notable example is *Tamarindus indica* (commonly known as tamarind)[3]; an evergreen ornamental tree native to tropical Central Africa. It can reach heights of 20–30 m and is characterized by a broad, spreading crown. Traditionally, tamarind has been employed – either alone or in combination with other herbs – to treat a wide array of ailments, including cardiovascular disease, pain, diabetes, constipation, fever, jaundice, parasitic infections, and respiratory disorders. It is also renowned for its laxative and aphrodisiac properties.

Numerous studies have demonstrated that various parts of the tamarind plant possess anti-diabetic and hypoglycaemic effects. Additionally, ethanolic extracts of *T. indica* fruits have exhibited hepatoprotective activity when administered orally to rats with alloxan-induced diabetes[4].

2. Methodology

Both aqueous and alcoholic extracts of *T. indica* were obtained from the Al-Amin Centre for Scientific Research in Najaf. Stock solutions were prepared by dissolving 500 mg of each extract powder in 5 mL of distilled water. Alloxan monohydrate was sourced from the Sigma-Aldrich Chemical Company (St. Louis, MO, USA), while glucose assay kits were procured from Bio Diagnostic Co. (USA).

Forty-nine adult male Sprague Dawley rats (average weight: 230 ± 20 g) were acquired from the Animal House of the Department of Life Sciences of the College of Science of the University of Kufa. The animals were housed in a well-ventilated laboratory under a 12-h light/dark cycle, at 24°C and 50%–52% relative humidity. Ethical approval for the study was granted by the Central Committee at the University of Kufa (approval number: 23793; date: 7 August 2024). The rats were randomly assigned to seven groups (n=7 per group; see Table 1): (i) group 1 (healthy control rats, orally administered normal saline for 30 days), (ii) group 2 (diabetic control rats, fed a basal diet without treatment for 30 days), (iii) group 3 (diabetic rats, orally administered aqueous *T. indica* extract at 500 mg/kg b.w. for 30 days), (iv) group 4 (diabetic rats, orally administered alcoholic *T. indica* extract at 500 mg/kg b.w. for 30 days), (v) group 5 (non-diabetic rats, orally administered aqueous *T. indica* extract at 500 mg/kg b.w. for 30 days), (vi) group 6 (non-diabetic rats, orally administered alcoholic *T. indica* extract at 500 mg/kg b.w. for 30 days), and (vii) group 7 (diabetic rats, subcutaneously injected with insulin at 6 IU/kg b.w. for 30 days). Diabetes was induced in the rats of groups 2, 3, 4, and 7 *via* a single intraperitoneal injection of freshly prepared alloxan (150 mg/kg b.w.) diluted in 10 mL of normal saline[5]. In order to prevent hypoglycaemic shock and mortality, rats were provided with a 5% glucose solution overnight post-injection.

At 72 h after the alloxan administration, blood samples were collected from the orbital plexus vein using capillary tubes. Rats with fasting blood glucose levels exceeding 200 mg/dL were considered diabetic; non-diabetic rats were excluded from treatment analysis. After a 30-day treatment period and a 12-h fast, rats were euthanized. Venous blood was collected in sterile centrifuge tubes for serum separation. Glucose levels were quantified using a glucose oxidase kit. This assay involves the oxidation of glucose to gluconic acid, with the resultant hydrogen peroxide reacting with phenol and 4-aminoantipyrine in the presence of peroxidase to form a violet-red quinonimine dye. The intensity of the dye correlates with glucose concentration, calculated using the formula:

$$\text{glucose concentration (mg/dL)} = 100 \times (\Delta A_{\text{sample}} / \Delta A_{\text{standard}})$$

Statistical analysis was performed using the SPSS software. Descriptive statistics (mean ± standard error) were computed, and intergroup comparisons were conducted using one-way analysis of variance (ANOVA) followed by the least significant difference

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Table 1. Effects of alloxan, the aqueous and alcoholic extracts of *Tamarindus indica*, and insulin on the blood glucose levels of male rats. Values represent the mean ± standard error (SE) for each group (n=7 rats per group). Means followed by different superscript letters within the same column differ significantly at $p<0.05$, as determined by one-way analysis of variance (ANOVA) and the least significant difference (LSD) test. The value of the latter was found to be 21.208.

Groups	**Blood glucose levels** (mg/dL; mean ± SE)
Group 1: control	109.8 ± 4.28 ^{cde}
Group 2: diabetes (150 mg/kg alloxan)	424.0 ± 6.11 ^{a}
Group 3: diabetes + aqueous extract of *T. indica* (500 mg/kg)	126.0 ± 8.61 ^{c}
Group 4: diabetes + alcoholic extract of *T. indica* (500 mg/kg)	112.6 ± 4.92 ^{cd}
Group 5: aqueous extract of *T. indica* (500 mg/kg)	92.8 ± 6.82 ^{de}
Group 6: alcoholic extract of *T. indica* (500 mg/kg)	89.2 ± 7.37 ^{e}
Group 7: diabetes + insulin (6 units/kg)	180.60 ± 9.98 ^{b}

(LSD) test at a significance level of $p<0.05$.

3. Results and Discussion

As shown in Table 1, statistically significant differences ($p<0.05$) were observed among the groups. Group 2 (alloxan-induced diabetic rats) exhibited a marked elevation in blood glucose levels (424.0 ± 6.11 mg/dL) compared to group 1 (healthy controls; 109.8 ± 4.28 mg/dL) and all other experimental groups. This finding corroborates previous studies[5,6], which have reported that alloxan at 150 mg/kg induces diabetes by damaging pancreatic β-cells responsible for insulin secretion[7]. Elevated glucose levels may also result from enhanced hepatic gluconeogenesis and impaired insulin synthesis.

Conversely, diabetic rats treated with *T. indica* extracts (groups 3 and 4) exhibited significant reductions in their blood glucose levels (126.0 ± 8.61 mg/dL and 112.6 ± 4.92 mg/dL, respectively) compared to untreated diabetic rats (group 2). These results are consistent with those of prior studies[8,9], which have employed similar extract concentrations and have demonstrated hypoglycaemic effects. The observed glucose-lowering activity may be attributed to the antioxidant properties of the bioactive compounds in *T. indica*, which potentially reduce oxidative stress, preserve β-cell integrity, and restore insulin levels.

Finally, the group 7 rats that were treated with insulin (6 IU/kg) have also shown a reduction in their blood glucose levels (180.60 ± 9.98 mg/dL), aligning with previous findings demonstrating that exogenous insulin promotes glycolysis and glycogen synthesis while inhibiting hepatic glucose output[10].

4. Conclusion

Both of the herein assessed extracts of *T. indica* have effectively reduced blood glucose levels in diabetic rats. The alcoholic extract appeared more potent, likely due to its superior antioxidant activity.

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Conflicts of interest

None exist.

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References

1. Yedjou C.G., Grigsby J., Mbemi A., Nelson D., Mildort B., Latinwo L., *et al.* The management of diabetes mellitus using medicinal plants and vitamins. *Int. J. Mol. Sci.* 24(10), 9085, 2023. DOI: 10.3390/ijms24109085
2. Rabizadeh F., Mirian M.S., Doosti R., Kiani-Anbouhi R., Eftekhari E. Phytochemical classification of medicinal plants used in the treatment of kidney disease based on traditional Persian medicine. *Evid. Based Complement. Alternat. Med.* 2022, 8022599, 2022. DOI: 10.1155/2022/8022599
3. Mukherjee D., Deb J., Kanti Deb N., Saha S., Chakraborty S. Ethnopharmacological, phytochemical and pharmacological review on *Tamarindus indica* L. *J. Pharmacogn. Phytochem.* 13(1), 120–126, 2024. DOI: 10.22271/phyto.2024.v13.i1b.14820
4. Chowdhury A.R., Sarkar B.K., Das A., Modak P., Halder S., Akter R., *et al.* Antidiabetic properties of some dietary fruits and vegetables commonly used in Bangladesh: a comprehensive review. *Int. J. Adv. Res. Pharm. Educ.* 2(1), 6–15, 2020.
5. Al-Doaiss A.A., Al-Shehri M.A. Protective effect of gum Arabic / insulin against histological changes in testes of diabetic rats. *Int. J. Morphol.* 38(2), 340–347, 2020. DOI: 10.4067/S0717-95022020000200340
6. Sadau Y., Maigari F.U., Siddan A.A., Nuhu M.N. Alloxan-induced diabetes causes liver functions and lipid profile changes in albino Wistar rats: role of ethanolic leaf extract of *Guiera senegalensis* (Combretaceae). *Niger. J. Pharm. Appl. Sci. Res.* 7(1), 15–21, 2018.
7. Hamadjida A., Metechie L.C., Tchiengang F.D.T., Otto G.L.N., Eteme O.N., Njintang N.Y., *et al.* Antidiabetic potential of *Hibiscus sabdariffa* extract in alloxan-induced diabetic rats. *GSC Biol. Pharm. Sci.* 23(1), 193–203, 2023. DOI: 10.30574/gscbps.2023.23.1.0158
8. Tekou F.A., Woumbo C.Y., Kemtsop M.P., Dzoyem J.P., Kuate D., Todem D. The antidiabetic activity of combining the aqueous extracts of *Vernonia amygdalina* leaves and *Tamarindus indica* fruit pulp in streptozotocin-induced Wistar rats. *Cureus* 15(10), e46807, 2023. DOI: 10.7759/cureus.46807
9. Koyaguru N., Kumar V.H., Jamadar M.G., Huligol S.V., Nayak N., Yendigeri S.M., *et al.* Antidiabetic and hepatoprotective activities of *Tamarindus indica* fruit pulp in alloxan induced diabetic rats. *Int. J. Pharmacol. Clin. Sci.* 2(2), 33–40, 2013.
10. Ahmed M.E., Gabr A.E.Z., Shams A.M., Sherif R.N., Taha R.I. Dapagliflozin *versus* insulin: which is better in treatment of diabetic nephropathy in albino rats, immunohistochemical study. *Egypt. Acad. J. Biol. Sci.* 14(1), 95–111, 2022. DOI: 10.21608/eajbsd.2022.221869

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