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Herbal Plant Extract as Hypoglycemic Agent in Streptozotocin (STZ)-Induced Diabetic Wistar Rats

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Abstract:

The therapeutic potential of medicinal plants is largely attributed to their rich content of secondary metabolites such as flavonoids, phenolic acids, and tannins, which demonstrate significant antioxidant activity. *Curcuma leucorrhiza* Roxb.is potential medicinal plant, exhibiting pronounced antiseptic, anti-inflammatory, and antioxidant functions. In-vivo studies revealed significant improvement in blood glucose levels, with a corresponding enhancement in the antioxidant profile supporting these effects. This study basically represents the effectiveness of herbal extract to cure diabetes mellitus without side-effect.

Keywords: Diabetes, wistar rats, Curcuma leucorrhiza, antioxidant, herbal extract

Introduction:

Medicinal plants are increasingly being explored as potential alternatives for the management of diabetes mellitus, a chronic condition characterized by persistent hyperglycemia and associated metabolic complications. Limitations of conventional antidiabetic drugs, including adverse effects and high costs, have driven interest toward safer and more affordable plant-based interventions. Medicinal plants are rich in bioactive compounds such as flavonoids, phenolic compounds, tannins, and alkaloids, which contribute to their therapeutic potential. These phytochemicals exert hypoglycemic effects through multiple mechanisms, including stimulation of insulin secretion, improvement of insulin sensitivity, inhibition of carbohydrate digestion, and reduction of oxidative stress. As oxidative stress plays a critical role in the progression of diabetes, the antioxidant properties of herbal extracts help protect pancreatic β-cells and maintain metabolic balance. Experimental models, particularly streptozotocin (STZ)-induced diabetic Wistar rats, are widely used to evaluate these effects, with studies demonstrating significant reductions in blood glucose levels and improvements in biochemical parameters. Therefore, herbal extracts represent a promising and sustainable approach for the development of novel antidiabetic therapies.

The genus *Curcuma* comprises several medicinally important plants that are rich in bioactive compounds with potential therapeutic applications against chronic diseases such as diabetes and cancer

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(Singh et al.,2014). Belonging to the family Zingiberaceae, *Curcuma* includes approximately 80 species and is widely distributed across India and other tropical and subtropical regions of Asia, particularly in countries such as Thailand, Indonesia, and Malaysia. Among these species, *Curcuma leucorrhiza* Roxb. is well recognized for its diverse pharmacological properties, including antiseptic, anti-inflammatory, antibacterial, antioxidant, antacid, antifungal, and carminative effects (Maithilikarpagasel et al., 2020; Debnath et al.,2025). In this study, the ethanolic extract of *Curcuma leucorrhiza* was administered to streptozotocin (STZ)-induced diabetic rats, and the antioxidant profile was subsequently evaluated to assess its association with the observed reduction in blood glucose levels and hypoglycemic activity.



Fig: Plant and rhizome of *Curcuma leucorrhiza* roxb.



Fig: Feeding of plant extract as antidiabetic agent to STZ induced Wistar rat

Success Story:

Under the guidance of Dr. M. Ayub Ali, I had the opportunity to explore the complex and serious disease diabetes mellitus during the course of my MVSc studies. For the in vivo study, 30 male Wistar rats were randomly allocated into five groups (n = 6): normal control (Group I), diabetic untreated (Group II), metformin-treated (5 mg/kg body weight; Group III), and ethanolic extract-treated groups receiving 100 and 200 mg/kg body weight (Groups IV and V, respectively). Treatment with the 200 mg/kg ethanolic extract markedly improved antioxidant status in diabetic rats, with effects comparable to metformin, as

evidenced by a significant reduction in malondialdehyde levels ($P < 0.01$) and a notable increase in catalase ($P < 0.05$), superoxide dismutase ($P < 0.01$), and glutathione peroxidase ($P < 0.05$) activities.

These findings validate the ethnomedicinal relevance of *Curcuma leucorrhiza* Roxb. and highlight its potential as a natural antioxidant intervention for mitigating diabetes-associated oxidative stress. Further investigations are required to isolate the active constituents, perform DNA sequence-based molecular characterization, and assess long-term therapeutic efficacy.

Numerous studies have demonstrated that plant extracts can significantly enhance serum antioxidant enzyme levels in diabetic rats. This effect is largely attributed to bioactive compounds such as flavonoids and polyphenols, which reduce lipid peroxidation and strengthen antioxidant defense mechanisms. In the present study, the improvement in antioxidant status observed in diabetic rats treated with *Curcuma leucorrhiza* Roxb. may be associated with its rich content of secondary metabolites, including curcumins, flavonoids, alkaloids, terpenoids, phenols, tannins, and saponins, which collectively contribute to its protective effects against oxidative stress.

Conclusion:

This study successfully demonstrated that treatment with *Curcuma leucorrhiza* extract improves the in vivo antioxidant status in streptozotocin (STZ)-induced diabetic Wistar rats. Among the tested formulations, the ethanolic extract showed the most pronounced therapeutic efficacy, significantly restoring antioxidant defenses. Induction of diabetes led to a decline in key antioxidant enzymes, including superoxide dismutase (SOD), catalase, and glutathione peroxidase (GPx), along with an increase in malondialdehyde (MDA) levels; however, these alterations were effectively ameliorated following treatment.

Nevertheless, the study relied primarily on morphological identification of the plant material, highlighting the need for future molecular characterization to ensure accurate species validation and consistency.

Research Publication:

In vitro Antioxidant activity and effect of ethanolic extract of *Curcuma leucorhhiza* Roxb. on *in vivo* antioxidant status of diabetic rats". Indian Journal of Experimental Biology Vol. 63, July 2025, pp. 612-619 DOI: 10.56042/ijeb.v63i07.15854

Patent:

Formulating and analysing the effect of curcuma leucorrhiza roxb. in treating experimentally induced diabetes mellitus, March 2025, Patent: ZA202406636B South Africa

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Roxb. on in vivo antioxidant status of diabetic rats: Hypoglycemic effect of Curcuma leucorhiza extract in diabetic rats. *Indian Journal of Experimental Biology (IJEB)*, *63*(07), pp.612-619.

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