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ANTIDIABETIC AND RENOPROTECTIVE EFFECTS OF ENICOSTEMMA LITTORALE IN INSULIN-RESISTANT RATS

Dr.K. Swathi Priya , *Department of Pharmacy,*
Srinivasa Rao College of Pharmacy, Madhurawada, Visakhapatnam, Andhra Pradesh

ABSTRACT

This investigation investigated the extent to which the whole plant extract of Enicostemma littorale was able to preserve kidney function and reduce blood sugar levels in insulin-resistant rodents. The therapeutic benefits of the plant extract were assessed by measuring blood sugar, insulin sensitivity, lipid profiles, renal function indicators, oxidative stress metrics, and kidney tissue morphology following insulin resistance. In insulin-resistant patients who were untreated, enicostemma littorale enhanced insulin sensitivity, blood sugar, and dyslipidemia. The extract restored antioxidant defenses and reduced renal tissue damage, blood urea nitrogen, serum creatinine, and other kidney disease indicators. The results suggest that Enicostemma littorale may be able to naturally address renal and insulin resistance. Diabetes and kidney injury may be prevented by antioxidants and metabolic regulation in plants.

Keywords: *Enicostemma littorale; Insulin resistance; Antidiabetic activity; Renoprotective effect; Oxidative stress; Hyperglycemia; Renal function; Phytotherapy; Histopathology Experimental rats.*

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1. INTRODUCTION

Diabetes induces elevated blood glucose levels. This disorder may be caused by insulin resistance or insufficiency. Type 2 diabetes is distinguished by adiposity, insulin resistance, and inactivity. Chronic insulin resistance affects the metabolism of glucose, protein, fat, and carbohydrates. Chronic hyperglycemia may exacerbate the development of diabetes-related comorbidities, particularly renal issues, by increasing oxidative stress, inflammation, and advanced glycation end products. The objective of research is to create diabetes treatments that enhance insulin efficacy and alleviate symptoms.

Microvascular injury from diabetic nephropathy is more likely to lead to renal degeneration and end-stage renal disease. Oxidative stress, mitochondrial dysfunction, inflammatory cytokines, and signaling pathways that promote fibrosis are the result of long-term renal tissue hyperglycemia and insulin resistance. Tube damage, glomerular enlargement, renal failure, and proteinuria are the results of these modifications. Conventional antidiabetics regulate blood sugar levels; however, they may cause kidney damage over time. As a result, researchers are investigating the potential of botanicals to decrease blood sugar levels and preserve kidney function.

Enicostemma littorale, a member of the Gentianaceae family, is used to treat diabetes and metabolic disorders. Phenols, flavonoids, alkaloids, saponins, and swertiamarin are among the bioactive phytochemicals. These substances exhibit insulin-sensitizing, anti-inflammatory, antioxidant, and antihyperglycemic properties. Research indicates that E. Littorale enhances insulin effectiveness, glucose metabolism, oxidative stress, and diabetes prevention. Insulin-resistant metabolic disorders and renal impairments may be enhanced by chemical properties. The study of the kidney protection and blood glucose reduction mechanisms of Enicostemma littorale in insulin-resistant animals has the potential to aid in the management of diabetes.

2. TYPES OF DIABETES

There are two types of diabetes:

- Type 1 DM (T1DM)
- Type 2 DM (T2DM)

Insulin resistance and diminished efficacy are characteristics of type 2 diabetes, which is not insulin-induced. It is linked to smoking, obesity, sedentary lifestyle, poor nutrition, age, and gestational diabetes, and it accounts for more than 90% of global diabetes cases.

Prevalence of Diabetes

Diabetes has approximately doubled in prevalence since 1980 and is rapidly increasing on a global scale. Diabetes is more prevalent in ascending nations due to urbanization, reduced physical activity, and dietary modifications. It is probable that the incidence of diabetes, the most prevalent cause of mortality worldwide, will increase in India. The necessity for improved prevention and early intervention is underscored by the increasing prevalence of diabetes.

Management of Diabetes

Pharmacological and lifestyle modifications are required to effectively manage diabetes. Diet, exercise, weight management, and lifestyle modifications are indispensable for the management of Type 2 diabetes. The majority of Type 2 diabetes can be managed through lifestyle adjustments and the use of insulin or oral hypoglycemics. The replacement of insulin is necessary for the treatment of Type 1 diabetes. Early identification and treatment are crucial for the prevention of deterioration and the mitigation of long-term consequences.

Antidiabetic Drugs and Their Limitations

Oral antidiabetic options consist of thiazolidinediones, secretagogues, α-glucosidase inhibitors, biguanides (e.g., metformin), and sulfonylureas. These medications reduce blood sugar by increasing insulin secretion, sensitivity, or carbohydrate absorption, or by reducing hepatic glucose synthesis. Although beneficial, prolonged use has numerous disadvantages, such as medication resistance, side effects, diminished efficacy, and inadequate protection against diabetes complications. Natural therapeutic compounds that exhibit enhanced efficacy are experiencing an increase in popularity.

Diabetic Nephropathy

Diabetic nephropathy, a microvascular consequence, is present in approximately 40% of diabetics. Renal injury is exacerbated by persistent insulin resistance and elevated blood glucose levels. End-stage renal disease is the result of kidney structural changes, including proteinuria, glomerular hypertrophy, tubular atrophy, glomerular basement membrane thickness, mesangial matrix enlargement, and a reduced glomerular filtration rate. Modern treatments frequently mitigate renal impairment; however, they may not prevent it.

3. BIOACTIVE PHYTOCHEMICALS FOR DIABETIC NEPHROPATHY

Phytochemicals, which possess drug-like properties, are present in medicinal plants. Numerous studies have demonstrated the health benefits of phytochemicals and bioactive compounds. This demonstrates their efficacy as natural modulators for the treatment of conditions such as diabetic nephropathy.

Health is promoted by plant phytochemicals. These consist of alkaloids, phenolics, flavonoids, terpenoids, and other compounds. Diabetic nephropathy is significantly impeded by these compounds.

Alkaloids: Fungi, bacteria, plants, and mammals generate alkaloids, which are chemical compounds that contain nitrogen. For instance, oxymatrine, trigonelline, magnoflorine, and berberine.

Phenolics: Phenylpropanoid generates secondary metabolites, including phenolics, by destroying plant shikimic acid and pentose phosphate. These polymers contain phenolic compounds that may be either simple or complex. They comprise hydroxyl-substituted benzene rings.

Examples: Resveratrol, Gallic acid, Syringaresinol, Mangiferin

Flavonoids: Flavonoids are the most diverse secondary metabolites found in plants. Phenolics are present in a variety of foods and beverages. Their core is composed of flavones (2-phenylchromen-4-one). Flavonoids are classified into flavones, isoflavones, flavanols, flavanones, and anthocyanins based on their functional groups.

Example: Hesperetin, Luteolin, Catechin, Genistein, Quercetin, Kaempferol

Terpenoids: Terpenoids, or isoprenoids, are present in a variety of plants, fungi, algae, and sponges.

Examples: Andrographolide, Astragaloside, Lupeol, Ursolic acid.

4. RENOPROTECTIVE MECHANISMS OF MEDICINAL PLANTS

Phytochemicals derived from medicinal plants are more secure than synthetic medications. We are unaware of their bioactive elements, pharmacological properties, hazards, or mechanism of action. Kidneys are safeguarded by plant compounds in numerous ways. The kidneys are safeguarded by medicinal plant extracts, which reduce oxidative stress, inflammation, AGE development, cell death, and tissue-damaging proteins. There is a wealth of information available regarding the names of plants, the formulations of extracts, the dosages, the working methodologies, and the animal models.

In test animals, oxidative stress and hyperglycemia were induced by diabetes-causing compounds, including STZ, alloxan, and HFD. Renal oxidative stress is the cause of diabetic nephropathy, which results in the formation of AGEs, cell death, and edema. Diabetic neuropathy may be precipitated by an absence of antioxidants. Oxidative stress induces an increase in the expression of NF-kB in the kidneys. The synthesis of inflammatory cytokines (IL-1β, IL-2, IL-6, IL-12, IL-18, and TNFα) and growth factors (TGF-β) is caused by this. Cell death-inducing proteins (Bax, Caspase-3, and Caspase-9) are elevated by NF-κB, while cell-stopping proteins (Bcl2) are diminished. Diabetic nephropathy is exacerbated by the reduction of kidney antioxidants (SOD, CAT, GPx, and GSH) by oxidative stress, which renders them incapable of safeguarding them from the deleterious effects of ROS. Inflammation is induced by the increased production of AGEs by the kidneys as a result of protein and lipid changes. The following variables are reduced and the kidneys are protected by medicinal plant extracts (MPE) in an animal model of diabetic nephropathy.

Medicinal Plants as an Alternative Source of Antidiabetic Agents

Plant-based molecules are best drug research leads. Plant-based medications are cheap, safe, and available. This is especially true in rural areas.

Plant bioactive chemicals provide several medical benefits without side effects. Plants provide medicinal compounds for numerous drugs.

Many plants were once the main source of powerful diabetes drugs. Medical herbs are used by many diabetics in developing nations because traditional medications are pricey. Diabetes treatment includes botanicals. Many phytochemicals lower glucose. Carotenoids, alkaloids, saponins, flavonoids, glycosides.

More insulin or less plant intestinal glucose absorption lowers blood sugar.

Diabetes' rising prevalence worries the public and medical community. Diabetes is treated with drugs and herbs. Worldwide, herbal and plant-based diabetes treatments without side effects are most popular. The majority of research demonstrates that blood sugar-lowering herbs reduce diabetes.

Treatment of diabetes and related illnesses with herbs. A recent study found that various medicinal plants can treat diabetes worldwide, including aloe, banaba, bitter melon, caper, cinnamon, cocoa, coffee, fenugreek, garlic, guava, gymnema, nettle, sage, soybean, green and black tea, turmeric, walnut, yerba mate, Fukugetin, berberine, honokiol, amorfrutins, trigonelline, gymnemic acids, and gur Pancreatic tissue boosts insulin synthesis, reduces intestinal glucose absorption, or activates insulin-dependent metabolites to lower blood sugar. Research reveals over 400 plant species lower blood sugar. Because certain chemicals have safe and diverse diabetes effects, scientists are still searching for natural antidiabetics. Anti-diabetic glycosides, alkaloids, terpenoids, flavonoids, and carotenoids are found in many plants.

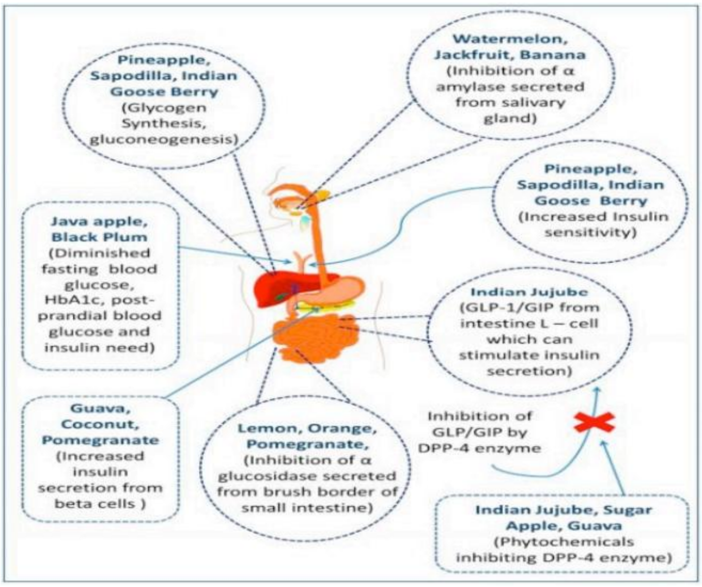

Figure 2: Mechanism of actions of plants exert antidiabetic activity

Table No. 1: List of plants having antidiabetic activity

Plant part	**Name of plants**
Aerial parts	Artemisia pallens, Bidens pilosa, Bixa orellana, Teramnus labialis
Bark	Cinnamomum zeylanicum, Croton cajucara
Bulb	Allium cepa, Allium sativum
Flower	Cassia auriculata, Gentiana olivier, Musa sapientum
Fruit	Carum carvi, Coriandrum sativum, Embellica officinalis, Juniperus communis, Momordica charantia, Xanthium strumarium
Leaves	Aloe barbadensis, Annona squamosa, Averrhoa bilimbi, Azadirachta indica, Beta vulgaris, Camellia sinensis, Cassia alata, Eclipta alba, Eucalyptus globulus , Euphrasia officinale, Ficus carica, Gymnema sylvestre, Gynura procumbens, Ipomoea aquatica, Mangifera indica, Myrtus communis, Memecylon umbellatum, Morus indica, Ocimum
Rhizome	Nelumbo nucifera
Roots	Clausena anisata, Glycerrhiza glabra, Helicteres isora, Pandanus odorus
Seed	Acacia arabica, Agrimony eupatoria, Lupinus albus, Luffa aegyptiaca, Lepidium sativum, Mucuna pruriens, Punica granatum
Stem	Amaranthus spinosus, Coscinium fenestratum
Tubers	Ipomoea batata
Whole plant	Abies pindrow, Achyranthus aspera, Ajauga iva, Aloe vera, Anacardium occidentale, Andrographis paniculata, Capsicum frutescens, Cryptolepis sanguinolenta, Enicostemma littorale, Ficus religiosa

Table No. 2: List of plants having insulin mimetic or insulin secreatory activity.

Plant botanical name	**Common name**	**Family**	**Mechanism of action**
Abies pindrow	Morinda	Pinaceae	Insulin secretagogue activity
Acacia arabica	Babool	Leguminosae	Release of insulin from pancrease
Agrimony eupatoria	Rosaceae		Insulin releasing and insulin like activity
Aloe barbadensis	Gheequar	Liliaceae	Stimulating synthesis and release of insulin
Annona squamosa	Sharifa	Annonaceae	Increased plasma insulin level
Averrhoa	Bilimbi	Oxalidaceae	Increase serum insulin level
bilimbi			
Bixa orellana	Annotta	Bixaceae	Increase plasma insulin concentration and increase insulin binding on insulin receptor
Boerhaavia diffusa	Punamava	Nyctaginaceae	Increase plasma insulin concentration

Camellia sinensis	Green tea	Theaceae	Increase insulin secretion
Capsicum frutescens	Mirch	Solanaceae	Increase insulin secretion and reduction of insulin binding on the insulin receptor
Cinnamomum zeylanicum	Dalchini	Dalchini	Dalchini Elevation in plasma insulin level
Clausena anisata	-	Rutaceae	Stimulate secretion of insulin
Eucalyptus globulus	Eucalyptus	Myrtaceae	Increase insulin secretion from clonal pancreatic beta line (BRIN-BD 11)
Ficus religiosa	Peepal	Moraceae	Initiating release of insulin
Hibiscus rosa	Gudhal	Malvaceae	Stimulate insulin secretion from beta cells
Helicteres isora	Indian screw tree	Sterculiaceae	Decrease plasma triglyceride level and insulin sensitizing activity
Ipomoea batata	Shakarkand	Convolvulaceae	Reduce insulin resistance and blood glucose level
Juniperus communis	Hauber	Pinaceae	Increase peripheral glucose consumption and induce insulin secretion
Olea europia	Olive	Oleaceae	19 Increase insulin release and increase peripheral uptake of glucose
Swertia chirayata	Chirayata	Gentianaceae	Stimulates insulin release from islets
Scoparia dulcis	Mithi patti	Scrophulariaceae	Insulin-secretagogue activity
Tinospora crispa	Giloe	Menispermaceae	Anti-hyperglycemic, stimulates insulin release from islets
Urtifca dioica	Bichhu booti	Urticaceae	Increase insulin secretion
Vinca rosea	Sadabahar	Apocynaceae	Beta cell rejuvenation, regeneration and stimulation
Zingiber officinale	Adrak	Zingiberaceae	Increase insulin level and decrease fasting glucose level

5. PLANT PROFILE

Enicostemma littorale

India has Gentianaceae perennial Enicostemma littorale Blume. Besides laxatives, this bittersweet plant cures rheumatism, fever, dermatological issues, gastrointestinal problems, snake envenomations, obesity, and glycemic management. The plant has antibacterial, antioxidant, antiulcer, anti-inflammatory, hypolipidemic, hepatoprotective, and hypoglycemic properties. This page details E. littorale's geographic range, physicochemical properties, phytochemical ingredients, and medicinal effects.

Figure 3: Plant of Enicostemma littorale

Vernacular names:

E. littorale has many Ayurvedic names, including No, MajaMakka booti, Vellarugu in Tamil, Vallari in Malayalam, White head in English, Chikka chiraayuta in Kannada, Mamajjakah in Sanskrit, Mamejavo in Gujarati, Nagajivha in Bengali, Chota chirayata in Hindi, Kaviyatu in Hindustani

Geographical distribution:

This tropical genus inhabits Asia, Africa, and South America. Savannas, grasslands, woods, coastal areas, and arid and wet settings support E. littorale. It resists high salinity.

6. CONCLUSION

Fructose-induced insulin-resistant rats revealed strong antidiabetic and renoprotective effects from Enicostemma littorale whole plant extract. By reducing kidney damage and oxidative stress, the extract improved glycemic management, insulin sensitivity, biochemical markers, and renal function. Flavonoids, phenolic compounds, alkaloids, and saponins with antioxidant and antihyperglycemic characteristics may explain these advantages. This suggests that Enicostemma littorale may be a promising natural therapy for insulin resistance and diabetes-related kidney issues. To verify its efficacy and safety for therapeutic uses, isolate active compounds, conduct mechanistic studies, and conduct clinical trials.

REFERENCES

[1] Soumya D., Srilatha B. Late stage complications of diabetes and insulin resistance. J. Diabetes Metab. 2011;2:1000167.

[2] Sperling M., Tamborlane M., Batteling T., Weinzimer S., Phillip M. Chapter 19: Diabetes mellitus. 4th ed. Elsevier; Amsterdam, The Netherlands: 2014. Pediatric endocrinology.

[3] Salsali A., Nathan M. A review of types 1 and 2 diabetes mellitus and their treatment with insulin. Am. J. 2006;13:349–361.

[4] Tripathy D., Chavez A.O. Defects in insulin secretion and action in the pathogenesis of type 2 diabetes mellitus. Curr. Diabetes Rep. 2010;10:184–191.

[5] Folorunso O., Oguntibeju O. Diabetes Mellitus—Insights and Perspectives. InTechOpen; Rijeka, Croatia: 2013. Chapter 5: The role of nutrition in the management of diabetes mellitus.

[6] Bahijri S.M., Jambi H.A., Al Raddadi R.M., Ferns G., Tuomilehto J. The prevalence of diabetes and prediabetes in the adult population of Jeddah, Saudi Arabia—A community-based survey. PLoS ONE. 2016;11:e0152559.

[7] Narayan K.M.V., Zhang P., Williams D., Engelgau M., Imperatore G., Kanaya A., Ramachandran A. How should developing countries manage diabetes? Can. Med Assoc. J. 2006;175:733–736.

[8] Levitt N. Diabetes in africa: Epidemiology, management, and health care challenges. Heart. 2008;94:1376–1382.

[9] DeFronzo R.A. Pharmacologic therapy for type 2 diabetes mellitus. Ann. Intern. Med. 1999;131:281–303.

[10] Inzucchi S.E. Oral antihyperglycemic therapy for type 2 diabetes—Scientific review. JAMA. 2002;287:360–372.

[11] Lebovitz H.E. Alpha-glucosidase inhibitors. Endocrinol. Metab. Clin. N. Am. 1997;26:539–551.

[12] Koski R. Oral antidiabetic agents: A comparative review. J. Pharma. Pr. 2004;17:39–48.

[13] Mayerson A.B., Inzucchi S.E. Type 2 diabetes therapy. A pathophysiologically based approach. Postgrad. Med. 2002;111:83–95.

[14] Wadkar K., Magdum C., Patil S., Naikwade N. Antidiabetic potential and Indian medicinal plants. J. Herb. Med. Toxicol. 2008;2:45–50.

[15] Khan N.U., Lin J., Liu X., Li H., Lu W., Zhong Z., Zhang H., Waqas M., Shen L. Insights into Predicting Diabetic Nephropathy Using Urinary Biomarkers. Biochim. Biophys. Acta BBA Proteins Proteom. 2020;1868:140475.