# CURRENT PERSPECTIVES ON THE ANTIDIABETIC AND ANTIOXIDANT PROPERTIES OF INDIAN KINO TREE

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***Abstract :-***

**Background: In Ayurvedic and Unani medicine, Pterocarpus marsupium Roxb. (Fabaceae), also referred to as the Indian Kino Tree or Vijayasar, has long been valued for its many therapeutic qualities. The phytochemical and pharmacological profile of this plant is attracting increased scientific attention as the prevalence of metabolic diseases increases worldwide.**

**Objective: In addition to its antibacterial, anti-inflammatory, and analgesic properties, this review attempts to summarize current viewpoints on P. marsupium's antidiabetic and antioxidant potential.**

**Methods: With an emphasis on important bioactive metabolites including Pterostilbene, (-)-Epicatechin, and Marsupsin, the study looks at a variety of plant sections, including the heartwood, bark, and leaves. It assesses information from in vivo preclinical models and in vitro tests (DPPH, alpha-glucosidase inhibition).**

**Results: There is evidence that P. marsupium uses a multi-target method. By blocking the enzymes that break down carbohydrates and, most importantly, by encouraging the regeneration of healthy pancreatic beta-cells, it successfully decreases blood glucose. Additionally, its high flavonoid and tannin content offers strong antioxidant protection by increasing endogenous enzymes like Catalase and Superoxide Dismutase (SOD) and neutralizing reactive oxygen species (ROS). According to toxicological evaluations, the plant is safe for long-term use and non-genotoxic.**

**Conclusion: Pterocarpus marsupium is a powerful natural remedy for Type 2 diabetes and its problems caused by oxidative stress. To standardize dosages for therapeutic usage in humans, more clinical research is advised.**

***Keywords :-*** **Pterocarpusmarsupium, Antidiabetic, Antioxidant, Pterostilbene, \beta-cell regeneration, Phytotherapy.**

## I. INTRODUCTION

One of the herbal remedies used in Ayurvedic, Unani, and homeopathic treatment is Pterocarpus Marsupium Roxb. (Fabaceae). Pterocarpus marsupium, also called the Indian Kino tree, asana, or vijayasar, is a huge deciduous tree that grows in subtropical regions of the world. Because marsupium is a good source of tannins and flavonoids, it is used to treat a variety of astringent conditions, including leprosy, leukoderma, toothaches, fractures, diarrhea, passive hemorrhage, and dysentery. It also aids researchers in their various pharmacological and phytochemical applications as well as qualitative research.[2] Herbal medicine has a long history dating back to the dawn of human civilization. It is particularly found in the regions of Madhya Pradesh, Bihar, Orissa, Kerala-Karnataka, and the Western Seven Ghats. Pterostilbene and marsupin, liquiritigenin, isoliquiritigenin, pterosupin, p-hydroxybenzaldehyde, 7, 4,-dihydroxyflavone, propterol, marsupol, and carsupin are the main phytoconstituents of P. marsupium.

Pterocarpus marsupium's various plant parts have been used to treat a variety of illnesses. For example, leaves have been used to treat skin conditions, flowers have been used to treat fever, gum-Kino has been used to treat diarrhea and dysentery, and bark has been used as an astringent and toothache remedy.[9, 10] The heart wood has anodyne, anti-inflammatory, anti-diabetic, and astringent qualities. In peninsular India, P. marsupium is renowned for its superior lumber, which is ranked second only to teak and rose wood. In Ayurveda, marsupium's wood and bark are recognized for their therapeutic qualities and anti-diabetic effects. Marsupium contains iso-flavonoids, terpenoids and related phenolic compounds, lophenol, epicatechin, and aurone glycosides, according to phytochemical research.

## II. PLANT DESCRIPTION

Plant shape and phenology P. marsupium is a straight-bole-producing, somewhat deciduous tree with spreading branches. The bark is roughly 1.25 cm thick, gray, rough, longitudinally fissured in small irregular scales, flame pink with whitish streaks, and elder trees release a blood-red, astringent gum resin. The leaves are rectangular, coriaceous, impar pinnate, 17.5–22.5 cm long, and typically have 5–7 leaflets. For a brief period during the hot season in April and May, the tree is almost evergreen or leafless; new leaves emerge in May and June. From June through September, panicles of fragrant yellow flowers bloom. The seeds are dolabriform, 1-1.25 cm long, reddish brown, fairly firm, and have a smooth, leathery testa. The pods are light yellowish brown, nearly orbicular, flat, winged, and have a diameter of 2.5–5 cm. When conditions are right, the tree can reach a height of 33 meters and a circumference of at least 2.6 meters. Wood is robust and long-lasting.





**Fig. No. 1.1**: Plant Profile (Indian Kino Tree)

## IDENTITY, PURITY AND STRENGTH

**Foreign Matter** – Not more than 2 per cent
**Total Ash** – Not more than 2 per cent
**Acid insoluble Ash** – Not more than 0.5 per cent
**Alcohol-soluble extractive** – Not more than 7 per cent
**Water-soluble extractive** – Not more than 5 per cent

## III. REPORTED PHARMACOLOGICAL ACTIVITY

### a) Antidiabetic activity

P. marsupium stem wood ethanolic extract exhibits antidiabetic properties. The usual medication glimepiride and ethanolic extract at doses of 200 mg/kg b. wt. (51.30%) and 400 mg/kg b. wt. (55.13%) had the greatest blood glucose-lowering effect (57.56%) in 180 minutes. The extract demonstrated dose-dependent and time-dependent antidiabetic efficacy. The ethanolic extract of heartwood (1gm/kg per oral and 2 gm/kg per oral) considerably. Bioassay demonstrated that extract fractionation had strong antidiabetic effects both in vivo and in vitro.

**b) CNS activity**

After being extracted from the bark, (-)-epicatechin was shown to affect the central nervous systems of rats, mice, and frogs. Rats, mice, and frogs' central nervous systems were found to be unaffected by (-)-epicatechindon. Propranolol is used to counteract the beneficial chronotropic and inotropic effects of (-)-epicatechin on frog hearts. Higher dosages (200 and 500 mg/kg b. wt.) of this substance cause hyperglycemia in rats; propranolol, which indicates adrenergic activity, also prevents this effect.

**c) Antioxidant activity**

In the 2,2-diphenyl-1-picrylhydrazyl (DPPH) radical scavenging method, P. marsupium stem wood extracts in ethanol, isopropyl alcohol (IPA), and acetone demonstrated antioxidant activity.[33] The highest 2,2-diphenyl-1-picrylhydrazyl free radical scavenging effect is obtained with methanolic extract (100 µg/ml), followed by ethyl acetate and aqueous extracts. With additional increases in extract concentration, the scavenging action reached saturation. This study demonstrated the P. marsupium bark extract's strong antioxidant activity against DPPH, superoxide, ABTS, hydroxyl radicals, nitric oxide scavenging, and in vitro lipid peroxidation suppression.

**d) Antimicrobial activity**

The disc diffusion method was used to assess the antimicrobial activity of P. marsupium aqueous and methanolic bark extracts. It demonstrated that the zone of inhibition for several extracts spans from 11 to 22 mm. By inhibiting A. Niger at 25 µg/ml and E. faecalis and S. typhi at 12.5 µg/ml, methanol extract had a substantial effect. P. marsupium was discovered to exhibit strong antibacterial activity against microorganisms.

**e) Antibacterial activity**

Gram +ve bacteria Bacillus coagulans and gram +ve bacteria Escherichia coli were tested against the methanolic extract of P. marsupium stem using the paper disc diffusion method. The growth of both bacteria was considerably suppressed at a dosage of 100 mg/ml.[37] The P. marsupium acetone and isopropyl alcohol extract (50 mg/ml) shown antibacterial action against Gram +ve bacteria (Bacillus cereus and Staphylococcus aureus), but not against Gram +ve bacteria (Salmonella Typhi and Escherichia coli). There was no antibacterial activity in the 50 mg/ml ethanol extract of P. marsupium.

**f) Anti-inflammatory activity**

Rat paw edema generated by carrageenan was used as an acute inflammation model to assess the anti-inflammatory effects of methanolic and aqueous extract. 50 mg/kg b. wt. of methanol extract and 100 mg/kg of aqueous extract Paw edema significantly decreased, according to b.wt. Both extracts were found to have strong anti-inflammatory properties.[39,40] 100 mg/kg and 200 mg/kg of P. marsupium aqueous extract A b.It was discovered to lower the high level of TNF-α, an inflammatory cytokine, in NIDDM diabetic rats.

**g) Antiulcer activity**

Both normal and NIDDM rats' blood glucose levels are lowered by P. marsupium methanolic heartwood extract (750 mg/kg b.wt). By affecting the rise in mucosal offensive (LPO and NO) factors and fall in defensive factors (superoxide dismutase and catalase), it preserved the mucosa. In normal rats, it showed no protection against ulcers brought on by aspirin, pylorus ligation, cold restraint stress, or ethanol.

### h) Analgesic activity

The analgesic effects of P. marsupium leaf extracts in methanol, ethyl acetate, and petroleum ether were tested in Swiss albino mice. The improvements in writhing response from several extracts were compared. 120 mg/kg of extract A in methanol b. It performed better than ethyl acetate and petroleum ether extracts.[44] The central analgesic effects of P. marsupium bark extract were evaluated in mice using the hot plate method. When compared to the standard, P. marsupium bark extract at a concentration of 500 mg/ml significantly increased reaction time.

### i) Antifungal activity

In a 10-day research, the alcoholic extract showed 78% and 93% excellent to good response after 7 and 10 days of therapy, while the aqueous extract showed 73%. As a result, it demonstrates that the alcoholic extract-based ointment works better than the watery extract. There was no side effect after continuous uses of drug for 10 days.

- **Toxic effects**

Due to its astringent nature, pterocarpus marsupium (PM) is not recommended while constipated. The genotoxic evaluation of PM was conducted using both somatic and germ cells because the herbal remedy for diabetes is administered for a longer period of time. The extract was not genotoxic, according to the findings. The effects of (-)-epicatechin, which was separated from PM, on the central nervous systems of frogs, rats, and mice were investigated. No harmful effects on the heart were found in the results. (-)-epicatechin showed no negative effects, even at greater doses. The blood glucose level dramatically dropped without any adverse effects, according to an ICMR study group that examined PM's antidiabetic activity at the multi-center level.

## IV. CURRENT PERSPECTIVES

### a) Anti-Diabetic Activity: Beyond Glucose Lowering :-

According to recent research, Pterocarpus marsupium actively fixes the metabolic machinery rather than merely "hiding" sugar.

- Enzyme Inhibition: Heartwood and bark extracts are strong inhibitors of alpha-glucosidase and alpha-amylase, according to contemporary in vitro tests. This slows the digestion of carbohydrates, preventing a sharp rise in blood sugar after a meal.
- beta-Cell Restoration: The plant's capacity to encourage the regeneration of functional beta-cells in the islets of Langerhans is a notable characteristic in recent in vivo (animal) studies. This may undo some of the harm brought on by long-term diabetes.
- Insulin Sensitization: Recent studies using HepG2 cell lines and in silico (computer modeling) research show that bioactive substances like pterosupin and epicatechin interact with the PTP1B protein, a crucial regulator that lowers insulin resistance.

### b) Antioxidant Properties: Neutralizing Oxidative Stress :-

Indian Kino Tree extracts serve as a barrier against the "oxidative stress" (cell damage) caused by diabetes.

- Radical Scavenging: Research utilizing DPPH and ABTS tests reveals a strong antioxidant potential, especially in the bark and heartwood methanolic and aqueous extracts.

- Protection of Organs: According to in vivo research, the extract increases the body's natural antioxidant enzymes, such as Catalase and Superoxide Dismutase (SOD), which helps shield the liver and kidneys from the damaging effects of diabetes.
- Mitochondrial Shield: According to recent research, the plant's flavonoids shield cells' mitochondria from being damaged by reactive oxygen species (ROS).

**c) Key Bioactive Metabolite :-**

According to recent studies, these characteristics' "active drivers" are as follows:

c) Pterostilbene: A powerful stilbene that mimics Metformin-like effects.
d) (-)-Epicatechin: Proven to enhance insulin secretion and provide restorative effects to the pancreas.
e) Marsupsin: Enhances glycolysis (the breakdown of glucose for energy).

Table No.01:Pharmacological profile of Pterocarpusmarsupium: Evidence from in vitro assays and in vivo preclinical studies

| **Property** | **Mechanism (In Vitro)** | **Observations (In Vivo)** |
|---|---|---|
| **Antidiabetic** | Inhibits \alpha-glucosidase; blocks PTP1B | Lowers HbA1c; regenerates Pancreatic \beta-cells. |
| **Antioxidant** | Scavenges DPPH and ROS radicals | Increases SOD and Catalase levels in liver/kidneys. |
| **Hypolipidemic** | Inhibits lipid peroxidation | Reduces LDL (bad cholesterol) and Triglycerides. |

## V. CONCLUSION

Pterocarpus marsupium, often known as the Indian Kino Tree, is a mainstay of traditional medicine with substantial therapeutic potential in contemporary pharmacology, according to a thorough evaluation of the literature. According to the data, it is a multifunctional agent for metabolic health with advantages that go well beyond basic blood glucose control. One of the most promising herbal remedies for Type 2 Diabetes and its consequences is still Pterocarpus marsupium. In order to bring this "ancient remedy" into mainstream clinical practice, future research should concentrate on human clinical trials and the creation of standardized phytopharmaceutical formulations, even though its traditional use is well-validated.

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