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Review Article

Phytopharmacological Properties of *Pterocarpus Marsupium Roxb.* (Indian Kino): A Review

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ABSTRACT

A deciduous tree native to India, Nepal, and Sri Lanka, *Pterocarpus marsupium Roxb*. is often referred to as *Indian Kino* or Vijaysar. This plant's heartwood, bark, leaves, and flowers are among the parts that have historically been used in Ayurvedic medicine for their medicinal qualities. Numerous bioactive substances, including terpenoids, phenolic acids, and flavonoids (including epicatechin), have been found in *P. marsupium* through phytochemical studies. These components support its wide range of pharmacological actions, including its cardioprotective, anti-inflammatory, antibacterial, antioxidant, and antidiabetic properties. The plant's capacity to improve glucose absorption and offer protection against oxidative stress in hepatic cells makes its antidiabetic action especially noteworthy, according to research. Furthermore, *P. marsupium* shows promise in treating hyperlipidaemia and cataract development, highlighting its therapeutic adaptability. The goal of this thorough review is to clarify the phytopharmacological characteristics of *Pterocarpus marsupium*, pointing out its possible uses in contemporary medicine and outlining directions for further study to fully realize its therapeutic potential.

INTRODUCTION

A mainstay of traditional medicine for generations, *Pterocarpus marsupium* is widely distributed throughout tropical and subtropical parts of South Asia. This tree, which is frequently called the "Indian Kino," has been used to treat a number of illnesses. *Pterocarpus marsupium's* leaves, bark, and heartwood contain bioactive chemicals that have medicinal promise. The main objective of this review is to present a thorough understanding of *Pterocarpus marsupium's* chemical makeup, biological activity, traditional use, and clinical significance [1].

1.1. Common Names in Different Regions

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Various names for the herb exist in different parts of the world, including Venga (Malayalam), Vengai (Tamil), Asanahm Asana, Beejaka, Bandhukavriksha (Sanskrit), Red Kino tree, Malabar Kino tree (English), Bijasal, Bila (Hindi), Vengai (Tamil), Yegi (Telgu), Piasal (in Orrisa), Malabar, Benga, and Bijiyasal (in western Nepal), and so forth [2]. The plant medication *Pterocarpus marsupium Roxb.* is a member of the rasayana group in the ayurvedic medical system [3]. Fever is treated with flowers, while leucorrhea and passive hemorrhage are treated with gum [4].

1.2. Growth & Distribution

The deciduous Pterocarpus marsupium Roxb. (Fabaceae) tree grows to a height of 90 feet or more. The leaves are oblong, wavy at the margins, obtuse, and 3 to 5 inches long with 5 to 7 leaflets. There are no stipules on the round, smooth, and waved petioles, which are 5 to 6 inches long. About 1.5 cm long, white flowers with a hint of yellow are present in large numbers. This tree's heartwood has a golden yellow colour. The gum from tree bark is reddish. The anthers are globose and have two lobes, while the stamens are ten and joined close to the base before splitting into two packages of five each. The legume is three-fourths orbicular and has a straight upper portion that runs from the pedicel to the rest of the style. The entire thing is encircled by a waved, veiny, downy, membrane-like Ing that is swollen, rugose, and woody in the middle, where the seed is lodged and does not open [5,6]. The plant species is indigenous to Nepal, India, and Sri Lanka. It is especially prevalent in the states of Gujrat, Madhya Pradesh, Bihar, and Orissa, as well as in some parts of the Western Ghats in the Karnataka-Kerala region [7].

1.3. History of Pterocarpus marsupium Roxb.

It has been used for many traditional and ethnobotanical purposes in many different civilizations for a very long time. It was regarded by many cultures as a remedy for every ailment. The heartwood of *Pterocarpus marsupium* is said to have the ability to produce medications for leprosy, skin conditions, diarrhoea, asthma, bronchitis, astringents, anti-inflammatory, and anthelmintics [8].

1.4. Medicinal Uses

Scientific reports have indicated that it contains anti-inflammatory, anti-ulcer, hepatoprotective, hypolipidemic, and anti-diabetic properties. Numerous phytochemical analyses have been conducted on this plant. According to phytochemical analysis, P. marsupium's methanol extract includes flavonoids, glycosides, carbohydrates, saponins, and tannins. The plant has been shown to have a wide range of biological activity. The *P. marsupium* tree is commercially exploitable due to its therapeutic properties. In addition to the chemistry of P. marsupium compounds, significant advancements in P. marsupium's biological activity and therapeutic uses have been made over the past 50 years. It is currently regarded as a valuable source of distinctive natural materials for the creation of industrial goods and medications to treat a variety of illnesses. The pharmacology of this priceless medicinal plant is revealed in this review, which also offers its phytochemistry, description, and therapeutic action for various conditions [9-13].



Fig. No.: 01 Pterocarpus marsupium Roxb.



2. Botanical Description

Scientific Name: Pterocarpus marsupium Roxb.

Common Name: Indian Kino

Family: *Fabaceae (legume)*

Type: Herbaceous perennial

Native Range: India - Gujarat, Madhya Pradesh, Chhattisgarh, Maharashtra, Jharkhand, Odisha, Karnataka, Kerala, Tamil Nadu, Andhra Pradesh, Telangana, Uttar Pradesh, Bihar and Himalayan (Sub-Himalayan tracts). **Nepal** – Madhya and Dakshina Bhag. **Sri Lanka** – Gammalu.

Growth Habit: Woody at the base, herbaceous at the top

Height: A medium to big deciduous tree, *Pterocarpus marsupium* can reach a height of 20 to 30 meters (66 to 98 ft). It has strength and stability due to its trunk, which can reach a thickness of 2 to 3 meters (6.5 to 10 feet). This tree has the potential to become considerably taller and more widely distributed in the right circumstances. [14]

3. Phytochemistry of *Pterocarpus marsupium*

Numerous phytochemical analyses of this tree's trunk and other portions, particularly its bark, have been conducted due to its potential medical benefits. In order to determine whether P. marsupium extract contained active chemical ingredients such alkaloids, flavonoids, tannins, phenolic compounds, saponins, fixed oils, and lipids, a preliminary phytochemical screening was conducted [15]. Moreover, different plant sections have yielded a wide range of flavonoids and their compounds. Polyphenolic compounds are abundant in it as well [16]. (Fig. 2) Pterostilbene. The blood glucose levels of hyperglycemic rats were considerably reduced by marsupsin and pterostilbene [17]. 5, 7, 2-4 tetrahydroxy isoflavone 6-6 glucoside was isolated; it is a strong antioxidant and is thought to help against heart disease [18]. Nevertheless, the heartwood of P. marsupium has lately yielded three significant phenolic constituents: pterosupin (Figure 3), marsupsin (Figure 4), and a wealth of polyphenolic chemicals [16]. The primary chemical thought to have an anti-diabetic action is epicatechin (Figure 5), a flavonoid that was isolated from bark and has the molecular formula $C_{15}H_{16}O_6$ [19, 20].



Stilbene, pterostilbene, β-eudesmol, triterpene alcohol, erythrodiol-3-monoacetate, catachin, epicatechin (Figure 5), pseudobaptigenin, liquiritigenin, garbanzol, 5-deoxykaempferol, chalcone, isoliquiritigenin, dihydrochalcone, pterosuprin and aromatic aldehyde, phydroxybenzaldehyde, marsupol (4,4~ dihydroxy-L-methylhydrobenzoin), and pterocarpols A and B were among the other compounds with known medicinal uses [21-25]. I, II, and 70-80% kinitannic acid are among its constituents, along 4.6.4-trihydroxyaurone-6-Owith rhamnopyranoside (I) and 4,6,4-trihydroxy-7methylaurone-4-O-rhamnopyranoside [26, 27]. Pterocarpus marsupium wood and bark ethanol extracts have recently been found to contain eight different chemicals [28]. Tetradecanoic acid (3.47%), 1, 2-Benzenedicarboxylic acid, di iso 3-O-Methyl-d-glucose octyl ester (7.56%), (73.31%), n-Hexadecanoic acid (9.19%), and 9, 12-Octadecadienoic acid (z, z) - (2.49%) were the chemicals identified in the Pterocarpus marsupium D-Friedoolean-14-en-3-one wood extract. (40.29%) was the most abundant component in its bark, followed by lupeol (33.24%), 3-0 methyl-dglucose (10.97%), 1, 2-Benzene (dicarboxylic acid), di-iso-ortyl ester (6.96%), n-hexadecanoic acid (4.42%), and 9, 12-octadecedienoic acid (z, z)- (3.03%).

4. Pharmacological Activities

S. No.	Plant Part	Pharmacological Activity
1.	Bark	Diabetes Management, Wound Healing, Gastrointestinal Disorders.
2.	Heartwood	Diabetes Management, Liver Protection, Skin Diseases.
3.	Leaves	Anti-inflammatory & Antiseptic, Antimicrobial Use, Oral Health.
4.	Seeds	Skin Care, Digestive Aid.
5.	Gum (kino	Astringent & Styptic, Antioxidant Properties, Eye Disorders.
	resin)	

4.1. Antihyperglycemic Activity

Glucose levels in rats with streptozotocin-induced hyperglycemia were assessed following intraperitoneal (i. p.) injection of three significant phenolic compounds of x's heartwood: marsupsin (1), pterosupin (2), and pterostilbene (3). In hyperglycemic rats, marsupsin and pterostilbene dramatically reduced blood glucose levels [29,17].

4.2. COX-2 Inhibition

Pterocarpus marsupium extract inhibits COX-2 specifically by reducing PGE2 synthesis [30,31].

4.3. Anti-inflammatory Activity

It has long been known that a number of plant species have anti-inflammatory properties. Boils, gleet (a fluid discharge from the urethra produced by a gonorrheal infection), urethrorrhea, odontalgia, psoriasis, and wounds have all been treated with *P. marsupium* for a long time in Indian medicine [18]. On the other hand, P. marsupium's aqueous extract was said to have antiinflammatory properties [32]. Mohammed Rageeb conducted the study to determine this plant's antiinflammatory capability [33]. The aqueous and methanol extracts were tested for their antiinflammatory properties utilizing a carrageenaninduced rat paw edema approach as an acute inflammation model. Their findings showed that, in comparison to the control group, methanol extract (50 mg/kg) demonstrated a good significant (p<0.001) reduction in paw edema from the second to the fourth hour, and that, at a dosage of 100 mg/kg, a nearly identical aqueous extract was significant after the first hour. Consequently, they deduced that both extracts (100 mg/kg) from the treated group had strong anti-inflammatory properties.

4.4. Antidiarrheal Activity



Diarrhoea is the second leading cause of infant mortality globally and a prevalent cause of death underdeveloped in nations. **Pterocarpus** marsupium has been shown to have anti-diarrheal properties in earlier studies [34]. The leaves, however, were used to treat gastrointestinal disorders [35]. Ethanolic heartwood extract of Pterocarpus marsupium dramatically decreased the incidence and intensity of diarrhoea at doses of 250 and 500 mg/kg. The hypothesis that flavonoids are the primary sources to suppress the intestinal secretary response brought on by prostaglandin E2 actually supports the studies [36]. Furthermore, flavonoids have antioxidant qualities that are thought to be the cause of the inhibitory effects they have on a number of enzymes, including those involved in the metabolism of arachidonic acid [37]. They therefore came to the conclusion that these components might be in charge of the ethanolic marsupium's extract of Р. anti-diarrheal properties.

4.5. Hepatoprotective Activity

P. marsupium stem bark methanol extract has hepatoprotective properties. Compared to the normal and standard medication silymarin-treated groups, the toxic effect of CC_{14} was considerably reduced in animals treated with methanol extract by restoring serum bilirubin, protein, and enzyme levels. The hepatoprotective action was further supported by the histology of the liver sections of the animals treated with the extracts, which revealed normal hepatic cords, no necrosis, and no fatty infiltration [38].

4.6. Anti-cataract Activity

The aqueous extract of *Pterocarpus marsupium* bark showed anti-cataract action. The reduced opacity index in the alloxan-induced diabetic rats made this clear [39].

4.7. Genotoxic Assessment

Research was done to assess the genotoxicity of this extract using both somatic cells and germ cells because the plant has been utilized as an antidiabetic drug for a longer period of time. The acquired results clearly show that the extract is not genotoxic on its own. Additionally, it decreased the cyclophosphamide's genotoxic effect in a dosedependent way that was similar to that of vitamin C, a known antimutagen. Therefore, this data unequivocally shows that this medicine has no genotoxic effects in mice [40].

4.8. Cardiotonic Activity

P. marsupium has a trace amount of phenolic content, according to the phytochemical study. Research indicates that they are the primary antioxidants that are thought to help prevent cardiovascular and other degenerative diseases. Glycosides and phenolic flavonolaglycone have a variety of biochemical effects, such as vasodilatory activities and the inhibition of platelet aggregation [41-42]. An antioxidant isoflavone Cglycoside macrocarposide that was extracted from P. marsupium heartwood and identified as 5, 7, 2-4 tetrahydroxy isoflavone 6-6 glucoside is said to reduce cardiovascular disorders [18,43]. Using the isolated frog heart perfusion technique (IFHP), they also found that, in contrast to digoxin (0.5 mg/ml), a medication with a restricted therapeutic window, its aqueous extract, which has a wide therapeutic window, provides good cardiotonic action.

4.9. Antifungal Activity

This medication was effective against T. cruris and T. corporis when applied topically. Three days after the initial administration, the medication produced a positive result [44].

4.10. Antimicrobial Activity

In an in vitro setting, the antibacterial activity of *Pterocarpus marsupium* was assessed against the pathogenic microorganisms Klebsiella



pneumonia, Pseudomonas aeruginosa, and Stahylococcus aureus. The least inhibitory concentration of *Pterocarpus* Marsupium's aqueous extract was between 0.04 and 0.08 mg, while extracts of F. bengalensis and H. indicus demonstrated inhibition against the tested bacteria at a range between 0.04 and 0.1 mg. Among the bacterial pathogens, S. aureus, K. pneumoniae, and P. aeruginosa were the most susceptible [45, 46].

4.11. CNS Activity

Pterocarpus Marsupium bark has been used to isolate (-)-Epicatechin. The effects of this flavonoid compound on the central nervous systems of mice, rats, and frogs were examined. Additionally, preliminary acute toxicity investigations were conducted. Rats and mice's central nervous systems were shown to be unaffected by (-)-epicatechin, but frog hearts had both positive chronotropic and inotropic effects that propranolol inhibited. Rats exposed to larger dosages of the chemical experienced hyperglycemia; propranolol also prevented this effect, indicating adrenergic-type activity. Even at greater dosages, (-)-Epicatechin was found to have no adverse effects [47].

4.12. Antianalgesic and Antioxidant Activity

The bark extract of *Pterocarpus marsupium* has the capacity to considerably lower the pain threshold and also lengthen the response latency period to thermal stimuli in mice, much like the reference medication pentazocine, according to research on the bark extract's central analgesic activity in mice using the hot-plate method. Mice's reaction times were considerably accelerated to two hours when given 500 mg mL-1 of bark extract, and they were likewise accelerated to two hours when given 5 mg kg-1 of pentazocine. The 1, 1-diphenyl-2-picrylhydrazyl test was used to assess the bark extract's in vitro antioxidant activity; the results were reported as IC50. As a standard, ascorbic acid's IC50 was 34.0 μ g mL-1, whereas the bark extract of *Pterocarpus marsupium* had an IC50 = 53.0 μ g mL [48].

5. CONCLUSION

Antihyperglycemic, anti-inflammatory, hepatoprotective, antidiarrheal, cardiotonic, and antibacterial qualities are just a few of the many therapeutic benefits of Pterocarpus marsupium, commonly referred to as the Indian Kino tree. Scientific attention has been drawn to its efficacy in controlling diabetes. To determine uniform dosages, methods of action, and possible longterm consequences, more clinical study is necessary. Developments in pharmacology and technology may open up new uses, and conservation measures are essential to guaranteeing the long-term viability of this priceless plant.

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