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Review Article

***Pterocarpus marsupium*: An Ethnopharmacological Treasure with Emerging Clinical Relevance**

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ABSTRACT

Pterocarpus marsupium, commonly known as Vijayasar, is an important medicinal plant widely used in traditional Indian systems of medicine for the treatment of metabolic and inflammatory disorders. This review summarizes available information on its traditional uses, phytochemical constituents, and pharmacological activities. Phytochemical studies reveal that the plant is rich in flavonoids, stilbenes, tannins, and other phenolic compounds, with epicatechin and pterostilbene identified as major bioactive constituents. Pharmacological investigations have demonstrated antidiabetic, antioxidant, anti-inflammatory, cardioprotective, hepatoprotective, antimicrobial, and wound-healing properties, providing scientific support for its traditional applications. Despite substantial preclinical evidence, clinical studies on *P. marsupium* remain limited, and issues related to standardization and dosage persist. Further well-designed clinical investigations and development of standardized phytopharmaceutical formulations are necessary to establish its safety and therapeutic efficacy.

INTRODUCTION

The world of plants provides us with a fascinating insight into the usefulness of plants in our world today; in fact some plants may hold the cure for such diseases as diabetes and skin disease, demonstrating that the value of plants is high in our world today, as others have discovered from long ago. As the modern way advances in technology, we should not forget the value of our plant

world.^[1] The treasure of India is stored in the vast natural flora, which has been boon to mankind. India is virtually herbarium of the planet.^[2] *Pterocarpus marsupium*. (Papilionaceae) is a deciduous tree commonly distributed in forests of the western ghats of India. The plant is commonly known as Asanahm bijakah (Sanskrit), Red Kino tree (English).^[3] It is native to India, Nepal and Sri Lanka, where it exists in parts of the Western

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Ghats.^[4] The plant has been extensively used in traditional systems of medicine such as Ayurveda, Unani, and Siddha for centuries, owing to its wide range of therapeutic properties. Among its various parts, the heartwood, bark, leaves, and gum resin have been most frequently employed for medicinal purposes.^[5] Traditionally, *P. marsupium* is best known for its antidiabetic potential and has been widely prescribed for the management of diabetes mellitus.^[6] Ancient Ayurvedic texts describe the use of its heartwood in the form of decoctions or water infusions for glycemic control.^[7] In addition to its hypoglycemic activity, the plant has been reported to possess anti-inflammatory, antioxidant, cardioprotective, hepatoprotective, antimicrobial, anti-obesity, and wound-healing properties.^[8] These diverse pharmacological effects are attributed to the presence of bioactive phytoconstituents such as flavonoids, stilbenes, phenolic compounds, terpenoids, and tannins.^[9] Phytochemical investigations of *P. marsupium* have led to the identification of several important compounds, including epicatechin, pterostilbene, marsupsin, and liquiritigenin, which are considered key contributors to its antidiabetic and antioxidant activities.^[10] Notably, epicatechin has been shown to promote pancreatic β -cell regeneration and insulin secretion, highlighting the therapeutic relevance of this plant in metabolic disorders.^[11] Recent advances in experimental and clinical research have further validated many of its traditional claims, thereby strengthening its importance in evidence-based herbal medicine.^[2] In recent years, increasing global interest in plant-based therapeutics has been driven by the rising prevalence of chronic metabolic disorders, adverse effects associated with long-term use of synthetic drugs, and the need for safer, cost-effective alternatives. In this context, *Pterocarpus marsupium* has attracted significant attention due to its multitarget pharmacological profile and long history of traditional use.^[12] Preclinical studies

have demonstrated its ability to modulate key biochemical pathways involved in glucose metabolism, oxidative stress, inflammation, and lipid regulation.^[13] These findings suggest that *P. marsupium* may offer therapeutic benefits not only in diabetes management but also in associated complications such as cardiovascular dysfunction, neuropathy, and hepatic disorders.^[14] Furthermore, advances in phytochemical analysis and pharmacological screening have facilitated a deeper understanding of the molecular mechanisms underlying the biological activities of *P. marsupium*.^[15] Compounds such as pterostilbene and epicatechin have been reported to exhibit insulin-sensitizing, antioxidant, and anti-apoptotic effects through modulation of signaling pathways including AMP-activated protein kinase (AMPK), peroxisome proliferator-activated receptors (PPARs), and nuclear factor- κ B (NF- κ B).^[16] Advances in in silico modeling, in vitro assays, and in vivo experimental designs have further supported its interaction with molecular targets such as glucose transporters (GLUT4), inflammatory mediators, and antioxidant defense systems.^[17]

TRADITIONAL USES OF *PTEROCARPUS MARSUPIUM*

In Ayurveda, the heartwood of *P. marsupium* is traditionally used for the management of Prameha (a group of metabolic disorders including diabetes).^[18] The heartwood is often soaked in water overnight, and the infused water is consumed orally to regulate excessive urination, thirst, and fatigue.^[19] It is also described as Tikta (bitter) and Kashaya (astringent) in taste, and is believed to balance Kapha and Pitta doshas.^[20]

The bark of *P. marsupium* has traditionally been used as an astringent and cooling agent, particularly in the treatment of diarrhea, dysentery, and bleeding disorders.^[19] Decoctions of the bark



are administered orally to manage gastrointestinal disturbances and are also used externally for wounds, ulcers, and skin conditions due to their drying and cleansing properties.^[19]

The gum resin, commonly known as kino, has been traditionally employed for its styptic and wound-healing purposes. It is applied externally to cuts, wounds, and ulcers to control bleeding and promote healing.^[19] Internally, kino has been used in small doses to treat chronic diarrhea and hemorrhagic conditions.^[19]



Pterocarpus marsupium Leaf

In Unani medicine, *P. marsupium* is used for conditions such as Zoaf-e-Jigar (weakness of the liver), urinary disorders, and excessive bleeding. Siddha medicine also recognizes the plant for treating urinary complaints, wounds, and metabolic imbalances.^[20] These traditional practices highlight the long-standing cultural and therapeutic importance of *Pterocarpus marsupium* in indigenous healthcare systems.^[21]



Pterocarpus marsupium Flower

Scientific classification of *Pterocarpus marsupium* ^[22]

Family	Fabaceae
Domain	Eukaryota
Kingdom	Plantae
Subkingdom	Viridaeplantae
Phylum	Magnoliophyta
Subphylum	Euphylllophytina
Class	Magnoliopsida
Subclass	Rosidae
Super order	Fabanae
Order	Fabales
Genus	Pterocarpus
Species	Marsupium

PHYTOCHEMICAL CONSTITUENTS OF *PTEROCARPUS MARSUPIUM*

Phytochemical investigations of *Pterocarpus marsupium* Roxb. have revealed the presence of a diverse array of secondary metabolites, which are largely responsible for its traditional and therapeutic relevance.^[9] Various parts of the plant, particularly the heartwood and bark, have been extensively studied and shown to be rich in phenolic compounds, flavonoids, stilbenes, tannins, and terpenoids.^[5]

Tannins ^[5,23,24]

The bark and heartwood of *P. marsupium* are rich in condensed tannins, which account for the astringent properties of the plant. The presence of kino tannic acid and related polyphenolic tannins has been well documented. These tannins are traditionally associated with the use of the plant in

treating diarrhea, dysentery, and wound conditions.

Terpenoids and Other Constituents ^[13,23,25]

In addition to polyphenols, *P. marsupium* contains terpenoids, sterols, and minor quantities of saponins and glycosides. Compounds such as β -sitosterol, lupeol, and other triterpenoids have been reported from the bark and leaves. The gum resin (kino) also contains complex mixtures of polyphenols and carbohydrates.

Distribution of Phytochemicals in Plant Parts

- **Heartwood** ^[9,11]: Stilbenes (pterostilbene), flavonoids (epicatechin), phenolics
- **Bark** ^[5]: Tannins, flavonoids, terpenoids
- **Leaves** ^[5,9]: Flavonoids, phenolic acids, sterols
- **Gum resin (kino)** ^[5]: Condensed tannins, polyphenols

PHARMACOLOGICAL ACTIVITIES OF *PTEROCARPUS MARSUPIUM*

Extensive pharmacological investigations have demonstrated that *Pterocarpus marsupium* Roxb. possesses a wide range of biological activities, which scientifically support its long-standing traditional use. These activities are primarily attributed to its rich phytochemical profile, particularly flavonoids, stilbenes, tannins, and other phenolic compounds present in different parts of the plant. ^[7,9,13]

Antidiabetic Activity

The antidiabetic activity of *P. marsupium* is the most extensively studied and well-established pharmacological property of the plant.^[7] Experimental studies have shown that extracts and

isolated compounds from the heartwood can reduce blood glucose levels, improve glucose tolerance, and enhance insulin secretion.^[11] A unique mechanism involving regeneration of pancreatic β -cells has also been reported. ^[11] Compounds such as epicatechin and pterostilbene are considered key contributors to these effects.^[9]

Antioxidant Activity

P. marsupium exhibits significant antioxidant potential by scavenging free radicals, inhibiting lipid peroxidation, and enhancing endogenous antioxidant enzymes. The antioxidant activity is mainly attributed to its high content of polyphenols, flavonoids, and tannins, which play an important role in protecting cells from oxidative stress-induced damage.^[26]

Anti-Inflammatory Activity

The plant has been found to possess diverse number of biological activities and is thus commercially exploited. In the present study, methanol and aqueous extracts of *P. marsupium* bark were used to evaluate in vitro antioxidant, anti-inflammatory and anti-haemolytic activities. In vitro antioxidant activity was carried out by DPPH, ABTS, phosphomolybdenum, reducing power assays, anti-inflammatory activity by inhibition of protein denaturation and anti-haemolytic by hyposaline induced haemolysis. Total phenolic and flavonoid content was also estimated.^[15]

Hypolipidemic and Cardioprotective Activity

Studies indicate that *P. marsupium* has hypolipidemic effects, including reduction of serum cholesterol, triglycerides, and low-density lipoprotein (LDL) levels. These properties contribute to its cardioprotective potential,



particularly in diabetes-associated cardiovascular complications.^[27]

Hepatoprotective Activity

Hepatoprotective effects of *P. marsupium* have been observed in experimental models of liver injury. Treatment with plant extracts resulted in normalization of liver enzymes and improvement in hepatic antioxidant status, indicating protection against toxin- and drug-induced hepatic damage.^[24]

Antimicrobial and Wound-Healing Activity

Extracts of *P. marsupium* have shown antimicrobial activity against various bacterial and fungal strains.^[28] Additionally, wound-healing studies suggest that the plant promotes faster wound contraction and epithelialization, supporting its traditional external use for wounds and ulcers.^[29]

CONCLUSION

Pterocarpus marsupium. remains one of the most valued medicinal plants in traditional Indian systems of medicine, with a long history of use in managing metabolic and inflammatory disorders. This review highlights that its traditional reputation is strongly supported by modern scientific investigations, particularly through the identification of diverse phytochemical constituents such as flavonoids, stilbenes, tannins, and other phenolic compounds. Among these, epicatechin and pterostilbene have emerged as key contributors to many of the reported pharmacological effects.

Experimental studies have demonstrated a wide range of pharmacological activities for *P. marsupium*, including antidiabetic, antioxidant, anti-inflammatory, cardioprotective, hepatoprotective, and wound-healing effects.

These activities are closely linked to the plant's rich phytochemical profile and the synergistic action of its bioactive constituents. Importantly, the ability of certain compounds to influence glucose metabolism and oxidative stress pathways provides a scientific basis for its long-standing traditional use.

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