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Review Article

Exploring The Medicinal Potential of Pterocarpus Marsupium: A Comprehensive Review

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ABSTRACT

Pterocarpus marsupium, commonly known as Indian kino or Malabar kino, is a deciduous tree native to India, Nepal, and Sri Lanka, renowned for its diverse medicinal properties. Belonging to the Fabaceae family, it is particularly valued for its anti-inflammatory, antidiabetic, and antioxidant effects, attributed to bioactive compounds such as flavonoids and phenolic acids found in its heartwood, bark, and leaves. Traditionally used in Ayurvedic and Unani medicine, P. marsupium has applications in treating diabetes, wound healing, and various skin conditions. Its ecological significance in sustaining biodiversity highlights its role in sustainable forestry. While generally considered safe, caution is advised regarding potential side effects and contraindications. Ongoing research into its pharmacological benefits and safety can validate its traditional uses and expand its relevance in modern healthcare practices, particularly for managing diabetes and skin health.

INTRODUCTION

Pterocarpus marsupium, also referred to as Malabar kino or Indian kino (1). Native to India, Nepal, and Sri Lanka, where it grows in some areas of the Western Ghats, Kino is known locally as "Bija." (2) is a noteworthy natural medicinal tree found in Southeast Asia and India's tropical regions. This species, which belongs to the Fabaceae family, is well-known for having a

variety of pharmacological qualities, such as anti-inflammatory, antidiabetic, and antioxidant effects. The reddish-brown heartwood of the tree, which has long been prized for its applications as a dye and in conventional medicine, is what makes it distinctive. Because P. marsupium has bioactive substances that enhance its medicinal efficacy—flavonoids and phenolic acids, in particular—research on the plant has become more

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concentrated. Research indicates that compounds derived from its leaves and bark show promise in controlling blood sugar levels, putting it forward as a supplemental treatment option for diabetes mellitus.(3) Moreover, the species is essential to ecological balance and biodiversity protection in sustainable Forestry and agro forestry systems.(4) Plants are indispensable to man for his life. Every plant phyta, including Pteridophyta, Spermatophyta, Bryophyta, and Thallophyta, has species that produce significant therapeutic compounds, both officially and unofficially. Herbal medicine has a long history that dates back To human civilization.(5) In the central, western, and southern parts of India, evergreen forests are home to Pterocarpus marsupium plants. It is primarily found in the states of Orissa, Bihar, Madhya Pradesh, and Gujarat.(6-7) The plant material has historically been applied externally to reduce inflammation and as aphrodisiac, antipyretic, anti-helminthic, alexithic, and in cases of biliousness, mental Abnormalities ,and ulcer.(8) In order to restore skin integrity, the wound healing cycle is a complicated and essential controlled succession of numerous well-organized biochemical and cellular activities. Wounds develop in three separate but overlapping stages during the healing process: infection, proliferation (neo-angiogenesis, granulation, re-epithelialization), and maturation (extracellular matrix remodelling [ECM]).(9) Plant is a vital component of human existence. Plants had been the source of medicine and prophylaxis until the 16th and 17th centuries,(10) when chemical medicine first appeared. Approximately 80% of the global population, who reside in developing nations, are thought to rely either directly or indirectly on traditional remedies such as herbal medicinal goods as their main source of healthcare and traditional medical care.(11) Plants are very valuable in our world today, as others have long since discovered. The world of plants gives us a

fascinating insight into the usefulness of plants in our world today; in fact, some plants may hold the cure for diseases like diabetes and skin diseases. As contemporary methods progress The value of our plant world should not be overlooked in the age of technology. For over two millennia, P. marsupium has been regarded as one of the most adaptable medicinal plants with a broad range of biological activity in India and its neighboring nations.(12-13)

Names

1. Indian Kino - Commonly used in English.
2. Malabar Kino - A name reflecting its native region.
3. Raktaksh - In Hindi, meaning "red eye," referencing its red sap.
4. Vijaysar - Another Hindi name, commonly used in Ayurvedic medicine.
5. Asan - A name in several Indian languages.
6. Kino Tree - General term in English referring to the tree's sap.
7. Pterocarpus - Scientific genus name that includes this species. (14, 15, 16, 17, 18, 19)

Synonyms

- Sanskrit: Bijaka, Pitasara, Asanaka, Bijasara Assamese: Aajar
- Bengali: Piyasala, Pitasala English: Indian Kino Tree Gujarati: Biyo
- Hindi: Vijyasara, Bija Kannada: Bijasara, Asana Kashmiri: Lal Chandeur Malayalam: Venga Marathi: Bibala
- Orissi: Piashala
- Punjabi: Chandan Lal, Channanlal Tamil: Vengai
- Telugu: Yegi, Vegisa Urdu: Bijasar (20,21)

Taxonomical Classification

- Domain : Eukaryota



- Kingdom : Plantae
- Subkingdom : Viridaeplantae
- Phylum : Magnoliophyta
- Subphylum : Euphylllophytina
- Infraphylum : Radiatopsis
- Class : Magnoliopsida
- Subclass : Rosidae
- Superorder : Fabanae
- Order : Fabales
- Family : Fabaceae

- Genus : Pterocarpus
- Species : marsupium (22-23)

Biological Source:

Pterocarpus marsupium is a deciduous tree belonging to the Fabaceae family, specifically within the subfamily Faboideae. It typically grows in tropical and subtropical regions, predominantly in India, particularly in the states of Madhya Pradesh, Maharashtra, and Karnataka. (24,25).

Chemical Class	Constituent	Source/Part of Plant	Reference
Flavonoids	Pterosupin	Heartwood	(26)
Flavonoids	Pterostilbene	Heartwood	(27)
Phenolic Compounds	Marsupinol	Heartwood	(28)
Phenolic Compounds	(-)-Epicatechin	Heartwood, Bark	(29)
Isoflavones	Biochanin A	Heartwood, Leaves	(30)
Triterpenoids	Betulinic acid	Bark	(31)
Triterpenoids	Lupeol	Bark	(32)
Glycosides	Pterocarposide	Bark	(33)
Oligomeric Proanthocyanidins	Procyanidins	Bark, Heartwood	(34)
Oligomeric Proanthocyanidins	Catechins	Bark, Heartwood	(35)
Tannins	Tannic acid	Bark, Heartwood	(36)

Phytochemistry: -

Pterostilbene, (2S)-7-hydroxyflavanone, isoliquiritigenin, liquiritigenin, 7,4'-dihydroxyflavone, marsupsin, pterosupin, p-hydroxybenzaldehyde, (2R)-3-(p-hydroxyphenyl)- lactic acid, and pm- 33 were observed in the ethyl acetate extract of powdered dried heartwood of Pterocarpus marsupium. (37) From the ethyl acetate fraction of Pterocarpus marsupium, Tripathi and Joshi identified three compounds: lupeol, naringenin, and retusin-8-O- α -L- arabinopyranoside (38). Pterocarpol was one of the chemicals obtained from the ethyl acetate

extra ct of the aqueous decoction of dried heartwood of Pterocarpus marsupium (39).

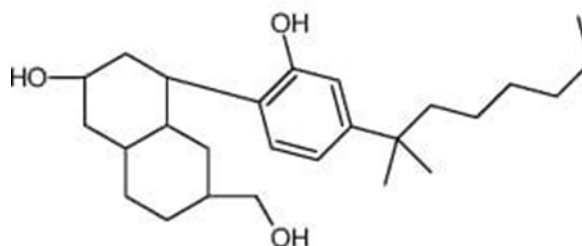


Fig. Marsupsin

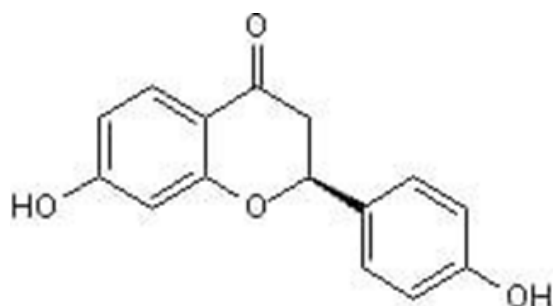


Fig Liquiritigenin

Biological Activity: -

1. Anti-diabetic activity:

- Marsupin, a compound isolated from *P. marsupium*, showed significant anti-diabetic activity in alloxan-induced diabetic rats.^[40]
- Ethanol extract of *P. marsupium* bark exhibited anti-diabetic activity in streptozotocin- induced diabetic rats.^[41]

2. Antioxidant Activity:

- Methanol extract of *P. marsupium* heartwood showed antioxidant activity against DPPH and ABTS radicals. [42]
- Flavonoids isolated from *P. marsupium* exhibited antioxidant activity in vitro. [43]

3. Anti-Inflammatory Activity:

- Ethanol extract of *P. marsupium* bark reduced inflammation in carrageenan-induced paw edema in rats. [44]
- Marsupin exhibited anti-inflammatory activity in lipopolysaccharide-stimulated macrophages. [45]

4. Antimicrobial Activity:

- Methanol extract of *P. marsupium* heartwood showed antimicrobial activity against bacterial and fungal strains. [46]

- Pterocarpine, a compound isolated from *P. marsupium*, exhibited antimicrobial activity against *Staphylococcus aureus* and *Escherichia coli*. [47]

5. Anticancer Activity:

- Ethanol extract of *P. marsupium* bark inhibited cancer cell growth in human breast cancer cell lines. [48]
- Marsupin induced apoptosis in human leukemia cells. [49]

Botanical Description

The tree is between a medium and giant size. The elevation spans between 15 and 30 meters. With branches that spread widely, the stem is sturdy and twisted. Thick, dark brown to grey-colored bark grows on the tree.^[50,51] Tree Features: *Pterocarpus marsupium* is a tall, deciduous tree that can reach heights of 20 to 30 meters. One to one and a half meters is the diameter of its straight trunk. Leaves: Usually having five to seven leaflets, the leaves are pinnately complex. Every leaflet is 7–14 cm long and oval to oblong in shape. Flowers: Clusters of tiny, yellow-to reddish-colored flowers are present. Usually seen in axillary racemes, they are bilaterally symmetrical and uneven. Fruits: Up to 10 cm in length, the fruit is a flat, elongated legume pod. lengthy and packed with seeds. When the pods mature, they turn dark brown.^[52]

Microscopy Of *Pterocarpus Marsupium*:

Microscopic Features:

Wood Anatomy:

Vessels: *P. marsupium* has large, simple, and bordered pit vessels that are predominantly diffuse-porous.

Fibers: The wood contains thick-walled fibers that contribute to its strength and density.

Parenchyma: Axial and radial parenchyma are present, with the former being abundant.

2. Leaf Anatomy:

Epidermis: The leaf has a thick cuticle, with stomata mainly located on the lower surface.

Mesophyll: Comprises a palisade layer and spongy mesophyll, adapted for efficient photosynthesis.

Vascular Bundles: Collapsed vascular bundles are observed, contributing to the leaf's mechanical support.

3. Stem Anatomy:

Growth Rings: Distinct growth rings are present, indicating seasonal growth patterns.

Phloem and Xylem: The arrangement is typical of dicotyledons, with xylem vessels forming a prominent part of the wood structure.^[53]

Parts Of Pterocarpus Marsupium Used in Cosmetic Products

1. Bark:

The bark is rich in antioxidants and has astringent properties, making it useful for skin toners and anti-aging products.

2. Wood:

The wood is often ground into powder and used in facial masks and scrubs for its exfoliating properties.

3. Leaves:

Extracts from the leaves can be used for their antibacterial and anti-inflammatory properties, beneficial in formulations for acne-prone skin.

4. Resin:

The resin has antimicrobial properties and can be included in formulations for healing ointments and creams.[54]

Methods Of Extraction

1. Infusion: For centuries, people have employed the heartwood of *Pterocarpus marsupium* to cure diabetes. To make "Beeja Wood Water," the heartwood-filled beakers are filled with water and let to stand overnight.[57] The dried heartwood of *Pterocarpus marsupium* was made into an aqueous extract by Mohire et al. by soaking it for 12 hours in a beaker filled with 100 millilitres of distilled water. The water bath was the focal point of the morning's collection of the brown-colored, light blue-shaded aqueous extract. The product was powdered after being dried with a rotary evaporator and then dried outside in the sun.[58] Central rough wood that had been dried and ground into a coarse powder was used by Bose and Sepaha. A 24-hour infusion was used to create the aqueous extract, with a strength of 1:8, which was cooked and eaten every day. They also made an infusion for seven days at the same strength.[59] Gupta immersed 50 grammes of wood sawdust in 500 millilitres of distilled water and let it to soak for the entire night at room temperature. This created the aqueous infusion of *Pterocarpus marsupium*. After gathering the liquid supernatant, the final volume was changed such that 10 millilitres of the infusion equalled one gramme of the crude medication. For later usage, the infusion was kept in a refrigerator at 4 °C in a sealed container.[60] The dried bark was ground into a fine powder by Vats et al., then the bark was soaked in an equivalent amount of water, agitated periodically,



and left overnight. The resulting pulp was filtered, and the filtrate was dried at a lower temperature before being lyophilised. Grover et al. and Vats et al. used an electric grinder to grind the bark of *Pterocarpus marsupium*. After being soaked in an equivalent volume of water and occasionally mixed, the powder was left overnight. Following a coarse sieve filtering of the pulp, the filtrate was dried at a lower temperature.[61-62] Grover et al. made the aqueous extract by using an electric grinder to ground the bark of *Pterocarpus marsupium* into a coarse powder. The resulting powder was then soaked in 1500 millilitres of distilled water, agitated occasionally, and left to stand motionless. The mixture was filtered through a muslin cloth-lined sieve after 36 hours, and the resulting filtrate was fully lyophilised to dry powder. This dry powder was kept in a cold storage.[63]

2. Decoction: According to the Ayurvedic Pharmacopoeia (1990), 50–100 grammes of the medication should be used for decoction.[64] One investigation involved pulverizing the dried heartwood of *Pterocarpus marsupium*, boiling it with distilled water until the volume was less than 100 ml, filtering it, and then adjusting the content back to 100 ml to create an extract.[65] One millilitre of the extract is equivalent to one gramme of the medication. *Pterocarpus marsupium* heartwood powder was made by Suri et al. by decocting it in boiling water and spray-drying it.[66]

3. Maceration: Ahmed et al. finely cut *Pterocarpus marsupium* wood and extracted it for a week in pure ethanol.[67] After gathering the heartwood, Joshi et al. chopped it into extremely tiny pieces. Methanol maceration lasted for seven days. After being vacuum-dried, the extract was kept in a refrigerator until it was needed again.[68] In one investigation, cold double maceration was

used to create an alcohol extract from *Pterocarpus marsupium* bark. The resulting extract was dried in a desiccator after being concentrated using a rotary flash evaporator.[69]

4. Percolation: Central heartwood that had been dried and ground into a coarse powder was utilised by Sepaha and Bose. Ninety-five percent alcohol was added to a percolator to create a 1:6 strength extract. [70-71]

Pharmacological Action

• Anti- diabetic activity: -

Pterocarpus marsupium has been shown to enhance insulin sensitivity, which helps in the regulation of blood glucose levels. This is particularly beneficial for individuals with type 2 diabetes. The extracts may influence glucose uptake and utilization by cells, potentially affecting pathways related to glycolysis and glycogen synthesis. Some studies suggest that the plant extracts may inhibit the enzyme α -glucosidase, which slows down carbohydrate digestion and absorption in the intestines, leading to lower postprandial blood sugar levels.[72]

• Antioxidant Activity

The presence of flavonoids and phenolic compounds in *Pterocarpus marsupium* enables it to scavenge free radicals, reducing oxidative stress and cellular damage. The extracts may enhance the activity of antioxidant enzymes such as superoxide dismutase (SOD) and catalase, further contributing to their protective effects against oxidative stress.[73]

• Cardiotoxic Activity

P. marsupium heartwood aqueous extract exhibits cardioprotective properties. This plant's pharmacological constituents, 5,7,2-4



tetrahydroxy isoflavone 6-6 glucoside, are strong antioxidants with potential cardioprotective effects. Digoxin was utilized as a reference and *P. marsupium* aqueous extract as a test extract, administered in a calcium-free Ringer solution.[74]

• **Anti-inflammatory Activity**

Additionally, *P. marsupium* has demonstrated promising anti-inflammatory properties. This work assessed the PGE2-inhibitory activity of a *P. marsupium* extract containing pterostilbene in LPS-stimulated PBMC. Additionally, *P. marsupium* extract's specific inhibitory efficacy against COX-1/2 was examined.[75]

• **Antibacterial Activity**

antimicrobial properties of *P. marsupium* leaf and bark extracts. Four chosen Gram-positive and Gram-negative bacteria were tested against hexane, ethyl acetate, and methanol extracts. It inhibits *Staphylococcus aureus*, *Streptococcus pyrogens*, and *Pseudomonas aeruginosa* in vitro. The bacteria were more susceptible to ethyl and methanol extracts than to hexane-based extracts. The antibacterial activity of the two extracts varied according to concentration.[76]

Ethnomedicinal Uses:

- 1. Diabetes Management:** Used to manage blood sugar levels.
- 2. Wound Healing:** Applied topically to wounds.
- 3. Skin Conditions:** Treats skin conditions like eczema and acne.
- 4. Fever Reduction:** Used to treat fever.
- 5. Digestive Issues:** Treats digestive problems.[77]

Traditional Uses:

- 1. Ayurvedic Medicine:** Used to treat various ailments, including diabetes and skin conditions.
- 2. Unani Medicine:** Used to treat digestive issues and fever.
- 3. Folk Medicine:** Used to treat wounds and skin conditions.
- 4. Tribal medicine:** Used to treat various ailments, including diabetes and digestive issues.[78]

Medicinal Use:

Pterocarpus marsupium has been traditionally used in Ayurvedic medicine for various purposes.

- Diabetes management (hypoglycemic effect).
- Wound healing and skin conditions.
- Anti-inflammatory and analgesic properties.
- Antimicrobial and antifungal properties.[79]

Cosmetic Use:

- Anti-aging and skin rejuvenation.
- Skin tone improvement.
- Acne and wound healing.
- Hair care products for scalp health and hair growth.[80]

Safety And Toxicity:

- Generally considered safe when used appropriately.
- High doses may cause gastrointestinal issues (nausea, vomiting, diarrhea).
- Allergic reactions (skin rash, itching) in rare cases.
- Contraindicated in pregnancy and breastfeeding due to lack of studies.[81]

Precautions:

- Consult healthcare professional before using *Pterocarpus marsupium*, especially if taking medications or having underlying health conditions.



- Monitor blood sugar levels when using for diabetes management.
- Avoid excessive consumption.[82]

Dosage:

- Traditional Ayurvedic dosage: 1-3 grams of dried bark or 1-2 teaspoons of extract per day.
- Modern recommendations vary; consult healthcare professional for personalized guidance.^[83]

CONCLUSION

Pterocarpus marsupium, commonly known as Indian kino or Malabar kino, is a highly valued medicinal tree native to India and its surrounding regions. With its rich history in traditional medicine, particularly within Ayurvedic and Unani practices, this species is renowned for its diverse pharmacological properties, including anti-diabetic, antioxidant, anti-inflammatory, and antimicrobial effects. The tree's various parts—heartwood, bark, leaves, and resin—are utilized in numerous applications, both medicinal and cosmetic. Key bioactive compounds such as flavonoids and phenolic acids contribute significantly to its therapeutic efficacy, making *P. marsupium* a promising candidate for complementary treatments in modern medicine, particularly for diabetes management and skin health. Furthermore, the ecological importance of *P. marsupium* in maintaining biodiversity underscores its role in sustainable forestry and agroforestry systems. Despite its benefits, caution is advised regarding its usage, especially concerning potential side effects and contraindications during pregnancy and breastfeeding. Overall, ongoing research into the pharmacological actions and safety of *Pterocarpus marsupium* can help to further validate its traditional uses and expand its application in contemporary health practices. Its potential in

addressing prevalent health issues, such as diabetes and skin disorders, positions it as a valuable resource in both traditional and modern medicinal landscapes.

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