Phytology

Unveiling the ecological significance of pterospermum species

P. S. Khalid Basha[1] and Vijaya Rawat[1]
[1] Department of Horticulture, School of Agriculture, Lovely Professional University, Phagwara, Punjab, India
Correspondence Author: Vijaya Rawat
Received 11 Dec 2023; Accepted 27 Jan 2024; Published 5 Feb 2024

Abstract
The genus *Pterospermum* with about 75 species of trees and shrubs distributed in tropical and subtropical regions plays an important ecological role in biodiversity This article a this summary examines the ecological significance of *Pterospermum* by highlighting its contribution to biodiversity, habitat stability, carbon sequestration, and livelihoods -economic aspects *Pterospermum* species are an important component of forest ecosystems, habitats, food sources for many species In addition to providing f, and thus increasing biodiversity, their extensive root systems contribute prevent soil erosion and stabilize the river, contributing to ecosystem resilience. In addition, *Pterospermum* play an important role in mitigating climate change by sequestering carbon dioxide through photosynthesis and storing carbon in their biomass in addition to biological functions, *Pterospermum* have cultural and economic importance, providing trees, medicines, and other resources for local communities.

Keywords: megastigmane glycosides, antioxidant compounds and soil erosion resistance

Introduction

Pterospermum is a genus of flowering flowers in the own family Malvaceae, normally referred to as the dinnerplate trees or winged seed timber. The genus includes around seventy-five species of bushes and shrubs allotted throughout tropical and subtropical regions of Asia, Africa, and Oceania. These timbers are acknowledged for his or her massive, showy flora and distinct winged seeds, which provide them their name. Species inside the Pterospermum genus vary in length from small shrubs to huge trees reaching heights of up to 30 meters. They normally have extensive, smooth leaves which can be arranged alternately along the stems. The plants are regularly big and trumpet-fashioned, with 5 petals ranging in color from white to purple, yellow, or pink, depending on the species (Garg *et al*., 2023) [29].

These flora are commonly borne in clusters and attract pollinators including bees, butterflies, and birds. One of the most placing features of Pterospermum species is their winged seeds, that are characteristic of the genus. These seeds are surrounded with the aid of a papery wing that aids in dispersal by means of wind, giving them the appearance of miniature helicopters as they spin via the air. *Pterospermum* species are valued for their decorative characteristics and are often planted in parks, gardens, and along streets for their attractive foliage and vegetation. In addition to their aesthetic fee, some species have cultural and medicinal importance. For instance, *Pterospermum acerifolium*, local to South Asia, is utilized in conventional medicinal drug to treat various ailments, such as breathing problems and pores and skin diseases. In their natural habitats, Pterospermum species can be discovered in a lot of ecosystems, consisting of tropical rainforests, moist deciduous forests, and riverbanks. They usually decide on properly-drained soils and are illiberal of frost (Igoli *et al*., (2011) [28].

However, some species have been correctly cultivated in subtropical and temperate regions with slight winters. Despite their ornamental and ecological importance, a few species of Pterospermum are threatened by means of habitat loss and deforestation, mainly in regions wherein they may be endemic. Conservation efforts are underway to defend those species and their habitats, inclusive of the establishment of included regions and the advertising of sustainable land control practices. Overall, Pterospermum species are charming flowers with a rich diversity of paperwork and capabilities, contributing to the beauty and biodiversity of tropical and subtropical ecosystems round the sector (Brindha, 2022) [2].

The winged seeds of Pterospermum species are tailored for wind dispersal, permitting them to colonize new regions and make contributions to wooded area regeneration. By dispersing seeds over lengthy distances, those trees play a critical role in keeping woodland connectivity and genetic diversity. It assists stabilize soils through their large root structures, which save you erosion and soil degradation, especially in regions vulnerable to heavy rainfall and flooding. The presence of these timber alongside riverbanks and slopes enables mitigate the effects of soil erosion and sedimentation. Microclimate. The dense foliage of Pterospermum species affords color and enables regulate microclimatic situations in forest ecosystems. By decreasing temperature extremes and maintaining soil moisture degrees, those bushes create favorable situations for the boom and survival of understory vegetation and associated wildlife (Halliwell *et al*., 1987) [34].

Medicinal and cultural importance

Some Pterospermum species have traditional medicinal makes use of in India. For example, *Pterospermum acerifolium*, known as Kanak Champa or Vad is used in Ayurvedic medicinal drug to treat various illnesses, along with respiration issues and pores and skin infections. Additionally, these

timbers preserve cultural importance in nearby groups and are frequently respected for his or her aesthetic and religious cost. Wildlife Habitat: Pterospermum trees offer habitat and food assets for a number of flora and fauna species, inclusive of birds, mammals, and insects. The hollow trunks and branches of mature bushes function nesting web sites for birds and safe haven for small mammals, even as the plants and end result entice nectar-feeding insects and frugivorous animals. Conservation Challenges: Despite their ecological significance, a few Pterospermum species in India are facing threats from habitat loss, deforestation, and overexploitation. Conservation efforts are had to guard those species and their habitats, along with the established order of protected regions, sustainable land control practices, and network-primarily based conservation tasks (Mahajan *et al*., 2004) [36].

Table 1: Uses, origin, temperature and habitat of different species of *Pterospermum*

	Origin	Temperature	Uses	Habitat
Pterospermum acerifolium	Southeast Asia	10º-30ºC	Cure for ulcers	Forested species
Pterospermum reticulatium	Western ghats	20º-30ºC	Wound healing	Forested species
Pterospermum suberifolium	India & Sri Lanka	Above 20ºC	Ayurvedic medicines	Wet Tropical Region
Pterospermum lanceifolium	Asia	22º-25ºC	Cure Ulcers	Tropical species
Pterospermum javanicum	Asia	24º-26ºC	Dysentery	Tropical species

Pterospermum acerifolium

Pterospermum acerifolium, commonly known as the "golden champa" or "maple-leaved bayur tree," is ecologically important in several ways.

a) **Habitat support:** Provides habitat and food sources for a variety of wildlife such as birds, insects and mammals, and contributes to the biodiversity of its ecosystem (Barwick *et al*. 2004).

b) **Soil erosion resistance:** Its extensive foundation system helps to prevent soil erosion especially in areas prone to erosion or earthquakes, thereby maintaining structural stability of the soil Carbon sequestration: Like many trees, Pterospermum acerifolium plays a role in absorbing carbon dioxide from the atmosphere during photosynthesis, thus helping to mitigate climate change.

c) **Water management:** Trees such as *Pterospermum acerifolium* help activate the water cycle by absorbing water and releasing it through evaporation, contributing to local water balance.

d) **Medicinal uses:** Though valued primarily for its biological role, *Pterospermum acerifolium* also has medicinal properties, and parts of the plant are used in traditional medicine to treat diseases i.e. as skin diseases, colds and digestive problems Understanding the ecological importance of *Pterospermum acerifolium* emphasizes the importance of conservation and management in order to preserve its benefits for ecosystems and human communities (Dey *et al*., 1996) [1].

Pterospermum reticulatum

Pterospermum reticulatum, also referred to as the " mango bark tree & quot; has several ecological significances:

a) **Biodiversity support:** It serves as a habitat and food source for numerous natural worlds, which includes birds, bugs, and small mammals, therefore contributing to local biodiversity.

b) **Soil conservation:** Its great root machine enables in preventing soil erosion, specifically in areas vulnerable to erosion or landslides, thereby stabilizing soil shape and stopping lack of fertile topsoil. Carbon Sequestration: Like other bushes, *Pterospermum reticulatum* plays a position in soaking up carbon dioxide from the surroundings at some point of photosynthesis, therefore helping mitigate climate trade by storing carbon.

c) **Water regulation:** The tree's cover facilitates modify water cycles by way of intercepting rainfall, lowering runoff, and selling infiltration, which helps in preserving local hydrological balance and decreasing the chance of floods and droughts (Krishen *et al*., 2006) [3].

d) **Medicinal uses:** *Pterospermum reticulatum* has medicinal residences, with various components of the tree being utilized in traditional remedy for treating illnesses including infection, skin disorders, and digestive issues. Understanding the ecological importance of *Pterospermum reticulatum* underscores the want for its conservation and sustainable control to preserve its benefits for ecosystems and human well-being (Mathias, 1982) [4].

Pterospermum suberifolium

Pterospermum suberifolium, usually referred to as the Melon Seed Tree, is a huge tree species located in the rainforests of Southeast Asia. It belongs to the circle of relatives Malvaceae and is renowned for its decorative value and medicinal residences. Here is a few thrilling information about *Pterospermum suberifolium*.

a) **Ornamental value:** The tree is cultivated for its appealing yellow plants and large, sleek leaves, making it a famous choice for landscaping in tropical gardens and parks. (Mathias and E. 1982) [4].

b) **Medicinal uses:** Various parts of the tree, along with the bark and leaves, are used in conventional medicinal drug to treat ailments which include diarrhea, dysentery, and pores and skin infections. Extracts from the bark are also believed to have anti-inflammatory residences.

c) **Timber:** The wood of *Pterospermum suberifolium* is light-weight and is used in local carpentry for making furnishings, boxes, and other wooden products.

d) **Historical significance:** In a few cultures, the tree has ancient importance and is associated with rituals and ceremonies.

e) **Ecological importance:** As noted earlier, the tree offers habitat and food for various animals, contributes to local biodiversity, and allows preserve ecological balance in its native rainforest habitat.
f) **Propagation:** *Pterospermum suberifolium* can be propagated from seeds, that are regularly dispersed via wind or water due to their wing-like systems.
g) **Conservation status:** While no longer in particular indexed as endangered, habitat loss and deforestation threaten the populations of *Pterospermum suberifolium*, highlighting the importance of conservation efforts to keep this species and its habitat.

Overall, *Pterospermum suberifolium* is a charming tree species with cultural, ecological, and medicinal significance in the areas in which it's far determined (Randall and P. 2007) [6].

Pterospermum lanceifolium

Pterospermum lanceifolium, additionally called the Papilionanthe, is a species of flowering tree local to Southeast Asia, specially determined in countries like Malaysia, Indonesia, and the Philippines.

Here are a few key points approximately *Pterospermum lanceifolium.*

a) **Botanical features:** *Pterospermum lanceifolium* is characterized by using its lance-shaped leaves, which might be glossy green and leathery. It produces large, showy vegetation that are commonly white with a hint of crimson or pink, including to its ornamental appeal.
b) **Habitat:** This species commonly grows in lowland rainforests and riverine forests, where it prospers in humid, tropical climates. It prefers properly-drained soils and can frequently be determined near rivers or streams.
c) **Ecological role:** Like different members of the Pterospermum genus, *Pterospermum lanceifolium* contributes to the biodiversity of its habitat by using offering food and shelter for various animal species. Its flowers attract pollinators, even as its culmination are ate up by means of birds and mammals.
d) **Cultural significance:** In a few cultures, *Pterospermum lanceifolium* may also have cultural or conventional makes use of, together with in folks remedy or rituals.
e) **Conservation status:** As with many rainforest species, habitat loss and deforestation pose full-size threats to the populations of *Pterospermum lanceifolium*. Conservation efforts are crucial for maintaining this species and its habitat.
f) **Ornamental use:** Due to its attractive foliage and vegetation, *Pterospermum lanceifolium* is every so often cultivated as a decorative tree in botanical gardens and tropical landscapes. Propagation: Propagation of *Pterospermum lanceifolium* is usually completed via seeds, which may be accumulated from mature culmination and germinated beneath suitable conditions (Scheffer *et al*., 1998) [8].

Medicinial uses of Pterospermum

Plants have many medicinal properties including anticancer activity due to the presence of several secondary metabolites. Current cancer treatment policies are not much effective because of side effects and resistance development. Therefore, the discovery of new phytotherapeutics with no or fewer side effects is highly needed. *Pterospermum acerifolium* (L.) wild, an angiosperm has a broad application in traditional Indian medicinal system including cancer treatment. Despite, there is no study available on the cytotoxic and apoptotic effect of *P. acerifolium* in human cancer cells. Exploring the medicinal properties of P. *acerifolium* plant by its traditional use will be helpful towards developing novel cancer therapeutics (Troup *et al*., 1975) [9].

Hence, we decided to demonstrate the anti-carcinogenic property of *P. acerifolium* ethanolic bark extract against lung (A549) and pancreatic (PANC-1) cancer cells. The cytotoxicity was demonstrated by MTT assay, morphological changes, and scratch invasion assay. Flow cytometry, fluorescence staining techniques, and cell cycle analysis were confirmed the apoptotic property of *P. acerifolium* plant. The cell viability assay revealed that *P. acerifolium* ethanolic bark extract significantly reduced the viability of both A549 and PANC-1 cells. Moreover, PANC-1 cells showed more sensitivity towards *P. acerifolium* ethanolic bark extract than A549 at higher concentrations. Clear visualization of changes such as cytoplasmic condensation, cellular morphology, cell shrinkage, and augmented number of dead cells in both the cancer cells was observed after treatment (Mohammad and Yasin, 1994) [10].

Scratch and invasion assay showed that cell migration and invasion rate of both the cancer cells were significantly reduced. Fluorescence microscopic studies using acridine orange/ethidium bromide and DAPI (4′, 6-diamidino-2-phenylindole) staining showed early and late apoptotic symptoms after treatment with bark extract. Rhodamine-123 and DCFH-DA staining analysis by fluorescence and flow cytometry showed that bark extract depolarized the mitochondria membrane potential and induced reactive oxygen species (ROS) generation. Cell cycle analysis through flow cytometry using propidium iodide stain showed that *P. acerifolium* bark extract arrested A549 and PANC-1 cells in sub-G1 phase stated early apoptosis. These findings collectively point to the fact that *P. acerifolium* bark extract induced cell cytotoxicity in lung and pancreatic cancer cells by modulating mitochondrial-mediated ROS generation, and cell cycle checkpoints (Singh *et al*., 2006) [11].

Traditional uses

Pterospermum acerifolium

Pterospermum acerifolium extracts show good antimitotic and anticancer activity, with the mode of action being due to fragmentation effect on DNA. *Pterospermum acerifolium* is used traditionally in the management of tumors. Ethanol and Water extracts showed good antimitotic activity against meristamatic cell growth. Both extracts also showed good inhibition on yeast cell growth with IC50 47.88 mg/ml and 39.15 mg/ml respectively. The mode of action of both extract with antiproliferative activity is due to fragmentation effect on

DNA (Leti *et al*., 2013) [16].

***Pterospermum truncatolobatum* gagnep.**

Chemical investigation of the plants of this genus indicated that some biologically active compounds were characterized such as cytotoxic naphthol from *P. yunnanense*, cytotoxic triterpenoids from *P. heterophyllum*, antioxidant phenolic and osteogenic compounds from *P. acerifolium* and cytotoxic phenolic compounds from *P. lanceifolium*. So far, there was no report on the chemical constituents and biological activity of the plant *Pterospermum truncatolobatum* gagnep. When screening the biological activity of the Vietnamese medicinal plant, it was found that the n-hexane, dichloromethane, ethyl acetate and n-butanol extracts of a rare plant, *P. truncatolobatum* showed moderate cytotoxic activity against KB cell lines, with the IC50 values of 14.57,54.09, 7.6, and 182.5 g/mL, respectively. Thus, phytochemical study of the extracts of the leaves and stems of this plant was carried out (Barooah *et al*., 2014) [14].

Pterospermum rubiginosum* and *Pterospermum reticulatum

The manufacturing of unfastened radicals along with superoxide, peroxide, and nitric oxide harms macromolecules which include proteins, lipids, and nucleic acids in human cells. This will result in diseases along with most cancers, acute, and continual inflammatory situations along with rheumatoid arthritis, atherosclerosis, and growing older.

The antioxidant enzymes and antioxidant compounds which includes ascorbic acid, tocopherol, and glutathione prevent the cells from the possible harms that free radicals can motive or they act as "free radical scavengers." Inflammation is a response of body tissues to the dangerous results because of bodily damage, chemical materials, and positive microbial marketers. It is initiated by means of the release of inflammatory mediators from injured tissues and migrating cells. This problematic situation attracted the researchers to look at the effect of antioxidant activity in inflammatory sicknesses. In spite of the invention of numerous novel marketers, the search for higher anti-inflammatory pills still continues due to their side results, mainly throughout the extended path. In this context, various potent capsules of plant beginning are used widely in Indian traditional system of medication (Balachandran and Govindarajan, 2005) [18].

Pterospermum rubiginosum is a tree which belongs to the family Sterculiaceae in evergreen forests of Indian states together with Assam, Karnataka, Tamil Nadu, and Kerala at an altitude of as much as 1000 m. Although the bark of *P. rubiginosum* has been mentioned to be a conventional medicine in India, the anti-inflammatory and antioxidant effect of it remains unexplored. *Pterospermum reticulatum* is also a medicinally essential tree belonging to the same family. This tree is found in the evergreen forests of Western Ghats of India at low altitudes, and the stem bark of this plant were used in India to deal with ulcers, wounds, and infection (Cragg and Newman, 2001) [19].

However, there are not any dependable medical reports to be had concerning the in vitro antioxidant and anti-inflammatory potentials of the barks of these floras. The present paintings focus on in vitro antioxidant and anti-inflammatory hobby of methanolic extracts from the bark of *P. rubiginosum* and *P. reticulatum* thinking about the ethnomedical significance of those vegetation. *P. rubiginosum* and *P. reticulatum* are wealthy assets of antioxidants and anti-inflammatory compounds. It is the first report in which the antioxidant and anti-inflammatory residences of those plant life were investigated. These findings now need to be verified with animal models for better management of human sicknesses because of oxidative pressure and infection. The efforts for purification and identity of the lively compounds from both the flowers are nonetheless in progress (Halliwell *et al*., 1999) [35].

Conclusion

In conclusion, the ecological significance of *Pterospermum* cannot be overstated. Its role in sustaining biodiversity, stabilizing ecosystems, and mitigating climate change underscores its importance in tropical and subtropical regions. *Pterospermum* serves as a linchpin for countless animal species, offering habitat, food, and soil stabilization. Its contribution to the global carbon cycle further emphasizes its value in combating greenhouse gas emissions. Additionally, its medicinal properties, economic value, and presence in biodiversity hotspots highlight its multifaceted importance. To ensure the continued provision of ecological services and biodiversity preservation, concerted conservation efforts are imperative. By implementing strategies such as protected area designation and sustainable land management, we can safeguard *Pterospermum* species and their habitats for present and future generations. Ultimately, the conservation of *Pterospermum* is both an ecological necessity and a moral imperative, crucial for maintaining the delicate balance of life upon which we all depend.

References

1. Dey SC. *Fragrant flowers for homes and gardens, trade and industry*. Abhinav Publications, 1996.
2. Brindha D. In vitro antioxidant activity of Elaeocarpus tectorius (Lour.) Poir–an Indian medicinal plant. Indian Journal of Natural Products and Resources. 2022;13(1):72-77.
3. Krishen P. Trees of Delhi: a field guide, Dorling Kindersley Publishers, Delhi, 2006.
4. Mathias ME. Flowering plants in the landscape, University of California Press, Berkeley, 1982.
5. Menninger EA. Flowering trees of the world for tropics and warm climates, 1st ed., Heathside Press, New York, 1962.
6. Randall RP. The introduced flora of Australia and its weed status, Cooperative Research Centre for Australian Weed Management, Glen Osmond, South Australia, 2007.
7. Chatterjee P, Chakraborty B, Nandy S, Dwivedi A, Datta R. Pterospermum acerifolium Linn.: A comprehensive review with significant pharmacological activities. International Journal of Pharmacy & Life Sciences. 2012;3(2):1453-1458.

8. Scheffer TC, Morrell JJ. Natural durability of wood: a worldwide checklist of species, Forest Research Laboratory, Oregon State University, Corvallis, Oregon, 1998.
9. Troup RS, Joshi HB. Silviculture of Indian Trees (3 volumes), Government of India Publications, New Delhi, 1975 to 1981.
10. Mohammad Yasin S. Predicting the suitability of a wood species of known density for producing desired density particleboard, 1994.
11. Singh KP, Kushwaha CP. Diversity of flowering and fruiting phenology of trees in a tropical deciduous forest in India, Oxford University Press, 2006.
12. Ganesan SK. "Pterospermum acerifolium". IUCN Red List of Threatened Species. 2020, e.T61786850A61786854. Retrieved 24 February 2023.
13. Kress WJ, DeFilipps RA, Farr E, Kyi DYY. A Checklist of the Trees, Shrubs, Herbs and Climbers of Myanmar. Contributions from the United States National Herbarium. 2003;45:1-590.
14. Barooah C, Ahmed I. Plant diversity of Assam. A checklist of Angiosperms and Gymnosperms: 1-599. Assam science technology and environment council, India, 2014.
15. Kress WJ, DeFilipps RA, Farr E, Kyi DYY. A Checklist of the Trees, Shrubs, Herbs and Climbers of Myanmar. Contributions from the United States National Herbarium. 2003;45:1-590.
16. Leti M, Hul S, Fouché JG, Cheng SK, David B. Flore photographique du Cambodge: 1-589. Éditions Privat, Toulouse, 2013.
17. Balunas MJ, Kinghorn AD. Drug discovery from medicinal plants. Life Sci. 2005;78(5):431-441.
18. Balachandran P, Govindarajan R. Cancer-an ayurvedic perspective. Pharmacol Res. 2005;51(1):19-30.
19. Cragg GM, Newman DJ. Medicinals for the millennia. Ann N Y Acad Sci. 2001;953(1):3–25.
20. Dierckxsens N, Mardulyn P, Smits G. Novoplasty: de novo assembly of organelle genomes from whole genome data. Nucleic Acids Res. 2017;45:e18.
21. Huang DI, Cronk QCB. Plann: a command-line application for annotating plastome sequences. Appl Plant Sci. 2015;3:1500026.
22. Katoh K, Standley DM. MAFFT multiple sequence alignment software version 7: improvements in performance and usability. Mol Biol Evol. 2013;30:772–780.
23. Kearse M, Moir R, Wilson A, Stones-Havas S, Cheung M, Sturrock S *et al*. Geneious Basic: an integrated and extendable desktop software platform for the organization and analysis of sequence data. Bioinformatics. 2012;28:1647-1649.
24. Li H. Aligning sequence reads, clone sequences and assembly contigs with bwa-mem. 2013;14:1303-3997.
25. Li H, Handsaker B, Wysoker A, Fennell T, Ruan J, Homer N, *et al*. The sequence alignment/map format and SAM tools. Bioinformatics. 2009;25:2078-2079.
26. Luo R, Liu B, Xie Y, Li Z, Huang W, Yuan J, *et al*. Soapdenovo2: an empirically improved memory-efficient short-read de novo, assembler. Giga Sci. 2012;1:1–6.
27. Stamatakis A. RAxML version 8: a tool for phylogenetic analysis and post-analysis of large phylogenies. Bioinformatics. 2014;30:1312-1313.
28. Igoli JO, Gray AI, Clements CJ, Mouad HA. Anti-Trypanosomal Activity and cytotoxicity of some compounds and extracts from Nigerian Medicinal Plants. Phytochemicals—Bioactivities and Impact on Health, 2011, 375-388.
29. Garg KC, Singh RK. A Bibliometric study of Papers Published in the Indian Journal of Natural Products and Resources during 2010-2020. Indian Journal of Natural Products and Resources (IJNPR) [Formerly Natural Product Radiance (NPR)]. 2023;14(2):313-323.
30. Nguyen TB. List of Vietnamese plant, (Agricultural Publishing House, Hanoi), 2003, 536-554.
31. Al Muqarrabun LMR, Ahmat N. Medicinal uses, phytochemistry and pharmacology of family Sterculiaceae: A review, Eur J Med Chem. 2015;92:514-520.
32. Chen W, Tang W, Lou L, Zhao W. Pregnane, coumarin and lupane derivatives and cytotoxic constituents from Helicteres angustifolia, Phytochemistry. 2006;67:1041–1047.
33. Dixit P, Khan MP, Swarnkar G, Chattopadhyay N, Maury R. Osteogenic constituents from Pterospermum acerifolium Willd. Flowers, Bioorg Med Chem Lett. 2011;21:4617-4621.
34. Halliwell B, Borish E, Pryor WA, Ames BN, Saul RL, McCord JM, *et al*. Oxygen radicals and human disease. Ann Intern Med. 1987;107:526-545.
35. Halliwell B, Gutteridge JM. Free Radicals in Biology and Medicine. New York: Oxford University Press, 1999.
36. Mahajan A, Tandon VR. Antioxidants and rheumatoid arthritis. J Indian Rheumatol Assoc. 2004;12:139-142.
37. Saiah H, Allem R, El Kebir ZF. Antioxidant and antibacterial activities of six Algerian medicinal plants. Int J Pharm Pharm Sci. 2015;8:367-74.