5 Ecological and medicinal significance of *Ficus arnottiana* (Miq.) Miq.

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ABSTRACT

Ficus arnottiana (Miq.) Miq. (Moraceae) is an ecologically and medicinally important tree species that is widely distributed across tropical and subtropical regions of India. This study highlights its dual role in ecosystem functioning and traditional healthcare systems. Ecologically, *F. arnottiana* serves as a keystone resource by producing fruits year-round, which sustain a wide variety of frugivorous birds, bats and other wildlife. Its obligate mutualism with fig wasps ensures effective pollination, while animal-mediated seed dispersal aids in forest regeneration and habitat restoration, especially in rocky and degraded environments. Medicinally, *F. arnottiana* has been widely used in traditional medicine for the treatment of wounds, skin diseases, inflammation, gastrointestinal disorders, diabetes and oral health issues. It contains bioactive compounds such as flavonoids, tannins and phenolics. These compounds contribute to its pharmacological properties, which include antioxidant, antimicrobial, anti-inflammatory and antidiabetic activities. *F. arnottiana* represents a valuable biological resource with significant ecological and therapeutic potential. However, further scientific validation, phytochemical standardisation and conservation strategies are necessary to ensure its sustainable use and integration into modern medicinal and ecological systems.

Keywords: Conservation, ecology, ethnomedicine, *Ficus*, fig

INTRODUCTION

The *Ficus* L. genus, belonging to the Moraceae family, comprises approximately 880 species that are widely distributed in tropical and subtropical regions around the world, including the Eastern Mediterranean, Asia, Africa, Australia and large areas of the Americas (Yuan et al. 2024; Madrigal-Santillán et al. 2024).

One notable species, *Ficus arnottiana,* is an important traditional medicinal plant found throughout India, particularly in rocky and hilly regions at elevations up to 1,350 m. Commonly known by its vernacular names, such as Paraspipal and Kodiarasu (Babu et al. 2017). This plant is highly valued for its rich phytochemical composition, which contributes to its diverse therapeutic applications. The fruits of *F. arnottiana* are reported to contain significant bioactive compounds, including β-sitosterol, gluanol acetate, glucose and friedelin, all known for their pharmacological properties. Additionally, the bark is rich in sterols, alkaloids, carbohydrates, tannins and phenolic compounds, highlighting its substantial medicinal potential (Mazumder et al. 2008**;** Babu et al. 2017).

Traditionally, various parts of the plant, especially the bark and leaves, are widely used in indigenous systems of medicine. The bark is recognized for its astringent, aphrodisiac, demulcent, depurative and emollient properties. It has been extensively utilized to treat a range of ailments, including inflammation, diarrhoea, diabetes, burning sensations, leprosy, ulcers, scabies, wounds and other skin diseases. Leaf extracts are also employed in traditional remedies, particularly for their wound healing and anti-inflammatory effects (Samy and Ignacimuthu 2000; Nadkarni 2007). Ecologically, *F. arnottiana* plays a significant role as a keystone species by providing fruits year-round, which serve as an important food source for birds, bats and other wildlife. Its mutualistic relationship with fig wasps ensures effective pollination and supports co-evolutionary relationships. The species also aids in seed dispersal through frugivores, promoting forest regeneration and maintaining biodiversity (Albrecht et al. 2017; Segar et al. 2025). Furthermore, its ability to thrive in rocky and harsh environments makes it an essential pioneer species for habitat stabilisation and ecological succession. Thus, the plant not only holds medicinal value but also significantly contributes to ecosystem sustainability and biodiversity conservation.

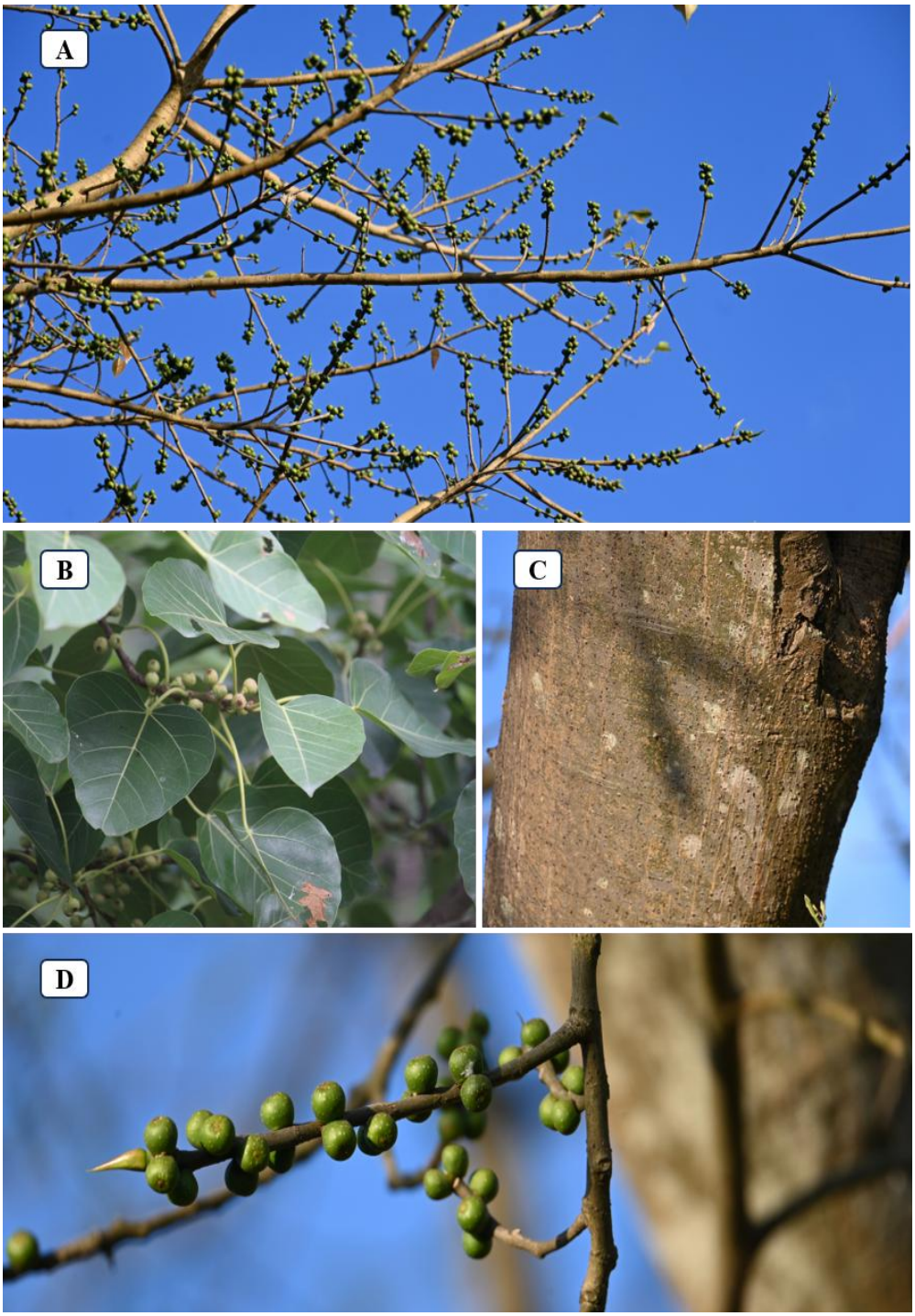


Figure 1: Vegetative parts of *F. arnottiana*; A) Canopy, B) Leaves, C) Bark, D) Fruits

MORPHOLOGY

Ficus arnottiana is a medium to large-sized deciduous tree, typically reaching a height of about 10–20 meters. It features a spreading crown with well developed branches, giving it a robust appearance. The species is commonly found in dry-deciduous forests and rocky habitats, indicating good adaptation to these conditions. The stem features a straight and moderately thick trunk. The bark is grey to pale brown and is smooth in younger individuals. A distinctive characteristic of the stem is the presence of milky latex that exudes when injured. The leaves are simple, alternate, and petiolate, with an ovate to elliptic shape that measures approximately 6-15 cm in length. The leaf apex ranges from acute to acuminate, while the base is rounded or slightly cordate. The margins are entire, and the texture is leathery (coriaceous). The upper surface of the leaf is dark green and glabrous, while the lower surface is lighter colour. The venation is both pinnate and reticulate. The inflorescence is a specialised structure known as a hypanthodium or syconium. It appears as a hollow, fleshy receptacle with a small opening called the ostiole at the apex. Numerous minute flowers are enclosed within this structure, making it a unique reproductive adaptation. The flowers are minute, unisexual, and sessile, situated inside the syconium. Male flowers are typically found near the ostiole, whereas female flowers are located in the inner regions. The perianth is reduced, and the flowers are not visible externally. The fruit is a syconus (fig), which is a modified inflorescence. It is globose in shape and small, typically measuring about 1-2 cm in diameter. The fruit is green when immature and turns reddish or purplish as it ripens. These fleshy fruits serve as an important food source for birds and other animals. The seeds are numerous, small, and embedded within the fleshy interior of the syconium. They are primarily dispersed by animals and birds that consume the fruits, facilitating zoochorous dispersal and aiding in the propagation of the species (Saxena and Bramham 1995; Figure 1).

ECOLOGICAL SIGNIFICANCE

Keystone species in ecosystems

F. arnottiana serves as a vital keystone species in tropical and subtropical ecosystems. Fig trees produce fruits multiple times a year, often during times when other food resources are limited. This consistent availability of figs supports a diverse array of frugivores and helps maintains ecological balance.

The loss of such species can significantly impact biodiversity and the functioning of ecosystems (Segar et al. 2025).

Food source for wildlife

The figs of *F. arnottiana* are an important food source for birds, bats, and other animals. Many fruit-eating species rely heavily on these figs, particularly during lean seasons. These fruits provide vital nutrition for birds such as barbets, pigeons, and bulbuls, as well as for mammals like bats and primates. Therefore, Ficus arnottiana is vital for maintaining faunal diversity (Albrecht et al. 2017).

Role in seed dispersal and forest regeneration

Animals that eat fig fruits play a crucial role in seed dispersal, a process known as zoochory, which helps with forest regeneration. *F. arnottiana* contributes to the establishment of new plants across landscapes, including degraded or open habitats. Fig trees are especially important for restoring ecological networks because they help maintain seed dispersal pathways and support the vegetation succession (Cottee-Jones et al. 2015).

Mutualism with fig wasps

F. arnottiana is pollinated by a specific species of wasp, ensuring successful reproduction. This highly specialised interaction represents a classic example of co-evolution and contributes to ecosystem stability by maintaining both plant and insect populations (Cottee-Jones et al. 2015).

Support for insect and bird diversity

In addition to frugivores, fig trees provide support for a diverse range of insects, including caterpillars and beetles that feed on their leaves and wood. Furthermore, fig trees indirectly benefit insectivorous birds by attracting insects that are drawn to the figs. Research has demonstrated that fig trees can enhance both the diversity and abundance of bird populations within ecosystems (Mackay et al. 2018).

Role in habitat stabilisation and colonisation

F. arnottiana typically thrives on rocky substrates and cliffs, playing a significant role in soil formation and stabilisation. Its roots penetrate rock crevices, slowly breaking them down and contributing to soil development. As

a result, it serves as an important pioneer species in harsh environments, facilitating ecological succession and habitat formation (Albrecht et al. 2017)

Importance in forest restoration

Due to their rapid growth, adaptability and ecological significance, fig trees, such as *F. arnottiana,* are widely used in forest restoration programs. They act as "framework species" that attract wildlife, enhance soil conditions and expedite ecosystem recovery in degraded areas (Kuaraksa 2012).

MEDICINAL SIGNIFICANCE

In traditional medicine, the latex and leaves of Ficus arnottiana are commonly used to treat skin ailments such as cuts, wounds, ulcers and infections (Table 1). The milky latex is applied topically to promote healing and prevent microbial infections, while pastes made from the leaves are used to reduce swelling and accelerate tissue repair. These practices are often observed in indigenous and rural healthcare systems (Kirtikar and Basu 1999; Jain, 1991). Additionally, the bark and leaves of this plant are traditionally used to alleviate inflammation, swelling, and joint pain. Decoctions prepared from the bark are administered to reduce internal inflammation, while leaf extracts are applied externally for relief from rheumatic pain. These applications highlight the plant's long-standing role in folk medicine for treating inflammatory disorders (Nadkarni 2007).

F. arnottiana is traditionally used to treat gastrointestinal issues such as diarrhoea and dysentery. Decoctions made from its bark, which are rich in astringent tannins, help reduce intestinal inflammation and control excessive bowel movements. This practice is common among tribal communities and Ayurvedic practitioners (Kirtikar and Basu 1999). In addition, extracts from the leaves or bark are employed in various traditional for managing diabetes. These preparations are believed to help regulate blood sugar levels when consumed regularly, highlighting their significance traditional diabetic care (Jain 1991). It is also used for treating boils, abscesses and ulcers. Poultices made from leaves or bark are applied to affected areas to draw out pus and promote healing. Its latex is occasionally used as a topical remedy for chronic ulcers due to its soothing and protective properties (Nadkarni 2007). In folk medicine, twigs of F. arnottiana are sometimes used as natural toothbrushes (chewing sticks) to maintain oral hygiene. The astringent and antimicrobial properties help strengthen gums and preventing oral infections (Jain 1991).

Table 1: Medicinal uses of *F. arnottiana*

Plant part (s)	Traditional use(s)	Mode of preparation/ applications
Latex	Treatment of cuts, wounds and skin infections	Applied topically on the affected area to promote healing and prevent infection
Leaves	Healing of wounds and reduction of swelling	Leaf paste applied externally on wounds and inflamed areas
Bark	joint pain, rheumatism	Bark decoction taken orally or applied externally
	Treatment of diarrhoea and dysentery	Decoction is used due to its astringent properties
Leaves/Bark	Management of diabetes	Extracts or decoctions are consumed traditionally
	Treatment of boils, ulcers	Poultice applied externally to the affected area
Twigs	Oral hygiene and gum strengthening	Used as chewing sticks (datun)

PHARMACOLOGICAL POTENTIAL

F. arnottiana is recognized for its notable pharmacological potential due to the presence of various bioactive compounds, including flavonoids, tannins, phenolics, saponins, and glycosides. It has been traditionally used and scientifically studied for its medicinal properties.

Anti-inflammatory and analgesic uses

Different parts of *F. arnottiana*, have traditionally been used to treat inflammatory conditions such as swelling, joint pain, and wounds. Experimental studies have demonstrated that extracts from this plant possess significant anti-inflammatory and analgesic properties. This activity is likely due to the presence of flavonoids and tannins, which inhibit inflammatory mediators. These finding support its use in managing pain and inflammatory disorders (Kirtikar and Basu 1999; Nadkarni 2007).

Antimicrobial activity

Extracts of *F. arnottiana* have shown antimicrobial activity against various bacterial and fungal pathogens. The presence of bioactive compounds, such as phenolics and tannins, plays a significant role in its ability to inhibit microbial growth. Traditionally, this plant is used to treat skin infections, wounds, and ulcers, as its antimicrobial properties help prevent infection and promote (Samy and Ignacimuthu 2000).

Antioxidant properties

The plant exhibits significant antioxidant activity because of its high levels of phenolic compounds and flavonoids. These antioxidants help neutralize free radicals, which reduces oxidative stress and protects cells from damage. This property is crucial for preventing chronic diseases, including cardiovascular disorders, diabetes, and cancer (Seema and Hemant 2024).

Antidiabetic potential

F. arnottiana has traditionally been used in the management of diabetes. Scientific studies suggest that its extracts may help regulate blood glucose levels by enhancing insulin secretion or improving glucose metabolism. The hypoglycemic effect is attributed to phytoconstituents such as flavonoids and glycosides (ul-ain et al. 2021).

Hepatoprotective activity

Extracts from *F. arnottiana* have demonstrated hepatoprotective effects by safeguarding liver cells from damage caused by toxins. This protective activity is primarily due to its antioxidant properties and the stabilisation of liver cell membranes, indicating its potential applications in treating liver disorders (Seema and Hemant 2024).

CONCLUSION

F. arnottiana is a plant of considerable ecological and medicinal importance, playing a vital role in both ecosystem stability and traditional healthcare systems. Ecologically, it acts as a keystone species by providing a continuous food source in the form of figs to a variety of birds, bats, and other wildlife, thus supporting biodiversity and maintaining trophic interactions. Its mutualistic relationship with fig wasps ensures specialized pollination, while its contribution to seed dispersal and the colonization of rocky habitats aids in forest regeneration and ecological succession. Medicinally, Ficus arnottiana

has been widely used in traditional medicine to treat wounds, skin diseases, inflammation, gastrointestinal disorders, diabetes and oral health issues. The presence of diverse bioactive compounds such as flavonoids, tannins and phenolics underpins its therapeutic potential, which is increasingly supported by pharmacological studies. Ficus arnottiana represents an essential link between ecological sustainability and ethnomedicinal heritage. Its dual role highlights the importance of conservation, sustainable utilisation, and further scientific research to fully explore its potential for both biodiversity conservation and drug development.

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