

CHAPTER 2

Ficus benghalensis: an ethnobotanical, pharmacological, and ecological analysis with phytochemical investigation of its bark

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Abstract: *Ficus benghalensis* Linn., popularly known as the banyan tree, is a prominent species within the Moraceae family, deeply rooted in the ethnomedicinal practices of various cultures worldwide. The present chapter comprehensively analyzes the traditional uses, pharmacological properties, and ecological significance of *F. benghalensis*, with a particular focus on the phytochemical analysis of its bark. Whole plant parts possess a wide array of ethnomedicinal uses, including diabetes, inflammation, diarrhea, dysentery, skin diseases and hemorrhoids. The chapter aims to provide a phytochemical perspective of the bark of *F. benghalensis*, which is a vital source of bioactive compounds.

Keywords: Ethnomedicinal, ecological, pharmacological, phytochemical

INTRODUCTION

The natural world has long served as an invaluable reservoir of therapeutic agents, with traditional medicine arrangements offering profound insights into the curative potential of various flora. *Ficus* is one of the largest genera



in the plant kingdom that belongs to the Moraceae family. *Ficus* is a genus of about 1,400 species of woody trees, shrubs, vines, epiphytes and hemi epiphytes in the family Moraceae **(Singh et al., 2023; POWO, 2025; Weiblen, 2000)**. They are popularly known as fig trees or figs. *Ficus* species are among the most popular houseplants in the form of bonsai **(Mewar et al., 2020)**. *Ficus carica* is believed to be one of the first plants cultivated by humans. Several fossils were discovered that date back to 9400 BC **(Barolo et al., 2014).**

Many species of *Ficus* serve in diverse forms for various purposes to mankind and ecosystem. Some are valued as ornamental plants, such as the fiddle-leaf fig (*Ficus lyrata*). Others are cultivated for their edible fruits, like the edible fig (*Ficus carica*). Prominent species within the genus include: banyan fig (*Ficus benghalensis*); roxburgh fig (*Ficus auriculata*); sacred fig (*Ficus religiosa*); rubber fig (*Ficus elastica*); weeping fig (*Ficus benjamina*) **(Singh et al., 2023; Patel and Gautam, 2014)**. Among these, *Ficus benghalensis* Linn, commonly known as the Banyan tree which belongs to the Moraceae family, stands as an iconic species, not only for its immense ecological significance and cultural reverence across the Indian subcontinent, but also for its extensive history of medicinal use **(Patel and Gautam, 2014)**. *Ficus benghalensis* (syn. *Urostigma benghalense). F. benghalensis* holds an immense role in the cultural significance of India and other parts of South and Southeast Asia **(POWO, 2025)**. Its sprawling growth, longevity, and unique aerial roots have fostered a rich tapestry of symbolism, religious beliefs, traditional practices, and community life. It is deeply revered in Hinduism, often considered the "tree of life" or "wish -fulfilling tree" (Kalpavriksha). It is believed to be the abode of the Hindu trinity. It depicts Lord Vishnu, Brahma, and the Shiva. Vishnu is believed to have the bark, Brahma, the roots and Shiva the branches **(Gopukumar and Praseetha, 2015)**.

Revered in ancient Ayurvedic, Siddha, and Unani traditions for millennia, virtually every part of the Banyan tree – from its bark and leaves to its aerial roots, fruits, and latex has been active in treating a remarkably diverse array of human ailments, including diabetes, inflammatory diseases, diarrhea, skin disorders, dysentery, fever, ulcers, and various infectious diseases **(Singh et al., 2023; Murugesu et al., 2021)**. Despite this rich ethnomedicinal heritage and compelling anecdotal evidence, a comprehensive scientific



understanding of its underlying therapeutic mechanisms and bioactive constituents remains an area of ongoing investigation.

For many years, many researchers have worked on its aspects to find bioactive compounds. Stem bark consists of anthocyanidin derivatives (methyl ethers of leucodelphinidin-3-O-L-rhamnoside, leucopelargonidin-3-O-L-rhaamnoside. Lecocyanidin-3-O-D-galactosylcellobioside) and aliphatic long chain ketones (pentatriacontan-5-one, tetratriacont-20-en-2one, heptatriacont-6-en-10-one), besides-beta-sitosterol glucoside and mesoinsitol. Bark consists of Leucodelphinidin derivative, bengaleno side: Aglucoside, Leucopelargonin derivative, leucocynidin derivative, glycoside of leucopelargonid. Leaves contain quercetin-3-galactoside, rutin, friedelin, taraxosterol, lupeol, β-amyrin along with psoralen, bergapten and β-sisterol **(Gopukumar and Praseetha, 2015; Singh et al., 2023; Chaudhary et al., 2015; Gopukumar et al., 2016).**

This chapter aims to provide a comprehensive analysis of *F. benghalensis*, integrating its deeply rooted ethnomedicinal claims with modern pharmacological validations, its critical ecological role, and a detailed phytochemical investigation of its bark, ultimately highlighting its potential as a source for novel Phyto therapeutics and emphasizing the imperative for its sustainability and conservation.

MORPHOLOGY

It is a large tree, epiphytic when young; branches sending down roots which form into accessory trunks; bark grey; new branchlets pubescent. Leaves approx. near the ends of the branchlets, ovate to elliptic, 10-17x 7-12 cm, coriaceous, old glabrous, or slightly pubescent beneath, young softly pubescent and often reddish, base rounded or subcordate, 3-5 nerved, secondary nerves 5-9 above the basal ones, looping close to margin and united by numerous close tertiaries and reticulate nervules which are not raised; petiole 1.8-4.3 cm long, glandular or mostly with a large flat, smooth gland beneath near the confluence of the main nerves; stipules 1.8 -2.5 cm long. Figs sessile in pairs, globose or sub-globose, 1.2 – 1.8 cm diam., scarlet when ripe, puberulous, with 2-4, more or less connate, broad, obtuse bracts at the base **(Saxenna and Brahmam, 1995; Figure 1-3)**.



Figure 1: Leaves of *F. benghalensis*



Figure 2: Syconium (fruits) of *F. benghalensis*



METHODOLOGY

The bark of *F. benghalensis* was collected from the nearby Mahanadi River area of Cuttack district of Odisha, and Ahilyanagar district of Maharashtra, India. The plant species was identified by the authors **(Figure 4; Nayak and Kumar, 2023)**. The Soxhlet extraction method was adopted using three solvents for phytochemical analysis **(Kumar et al., 2013; Marndi et al., 2025)**. Detection of nine secondary metabolites was conducted using standard methods **(Devi et al., 2023; Jena et al., 2024; Marndi et al., 2024; Figure 4-6)**.

Qualitative phytochemical analysis (Marndi et al., 2024)

Test for tannin: About 1 ml of the bark extract was taken. Three to five drops of 10% lead acetate solution were added. The gelatinous precipitate formation confirmed the presence of tannin.

Test for saponin: About 1 ml of the bark extract was taken and 1 ml of distilled water was added and shaken well. The formation of persistent froth was observed, confirming the presence of saponin.

Test for flavonoids: About 1 ml of the bark extract was taken. Two ml of 2% NaOH solution and 3 to 4 drops of diluted HCl were added. The colour initially turned to an intense yellow colour with NaOH solution and later became colourless. This colour change in appearance confirmed the presence of flavonoids.

Test for terpenoids: About 1 ml of the bark extract was added with 5-6 drops of chloroform and placed in the water bath for a few minutes. Then 5-6 drops of concentrated sulphuric acid were added. The reddish-brown interface confirmed the presence of terpenoids.

Test for phenolic groups: About 1 ml of the bark extract was taken. A few drops of 5% ferric chloride solution were added. The dark bluish-black appearance confirmed the presence of phenolic compounds.

Test for reducing sugars: About 1 ml of the bark extract was taken and 2 drops of Fehling's solution A followed by Fehling's solution B were added and kept in the water bath for some time. The presence of red-orange precipitate confirmed the presence of reducing sugar.



Test for steroids: About 1 ml of the bark extract was taken. 1 ml of chloroform and 1 ml of concentrated sulphuric acid was added to it. The appearance of upper red and lower yellow colors with green fluorescence provided the presence of steroids.

Test for alkaloids: About 1 ml of the bark extract was taken and 3 to 4 drops of Dragendroff's reagent were added. The formation of a reddish-brown precipitate confirmed the presence of alkaloids.

Test for carbonyl compounds: About 1 ml of the bark extract was taken and 3 to 4 drops of 2,4- Dinitrophenylhydrazine (DNPH) reagent were added. The formation of yellow crystals confirmed the presence of carbonyl compounds.

RESULTS AND DISCUSSION

During the field survey, it was noticed that tribal communities consumed the ripened fruit **(Figure 7)**. According to literature and field surveys, it is concluded that all parts of *F. benghalensis* have medicinal properties. Keeping this in mind, their medicinal values and biochemical studies were carried out in three extracts, such as N- hexane, ethanol and methanol **(Table 1; Figure 4-6)**. The present scenario concludes that some bioactive compounds in bark, including reducing sugars, are present in three extracts. Tannin is present in ethanol and methanol extract. Terpenoid is present in N-hexane. Phenolic compounds are present in ethanol and methanol extract. Alkaloids are present in ethanol and methanol extract. Phenolic compounds contribute significantly to antioxidant activity. Tannins are found in various parts, particularly in bark, contributing to astringent properties. Many avifaunal species relish ripened fruits as these fruits are also one of the sources of food for these avifaunal species **(Figure 8)**.

Table 1: Phytochemical screening using different extracts of *F. benghalensis* bark

Bioactive compounds	N- hexane	Ethanol	Methanol
Tannin	-	+	+
Saponin	-	-	-
Flavonoid	-	-	-
Terpenoids	+	-	-

Phenolic compounds	-	+	+
Reducing sugars	+	+	+
Steroids	-	-	-
Alkaloids	-	+	+
Carbonyl compounds	-	-	-



Figure 3: Bark of *F. benghalensis*

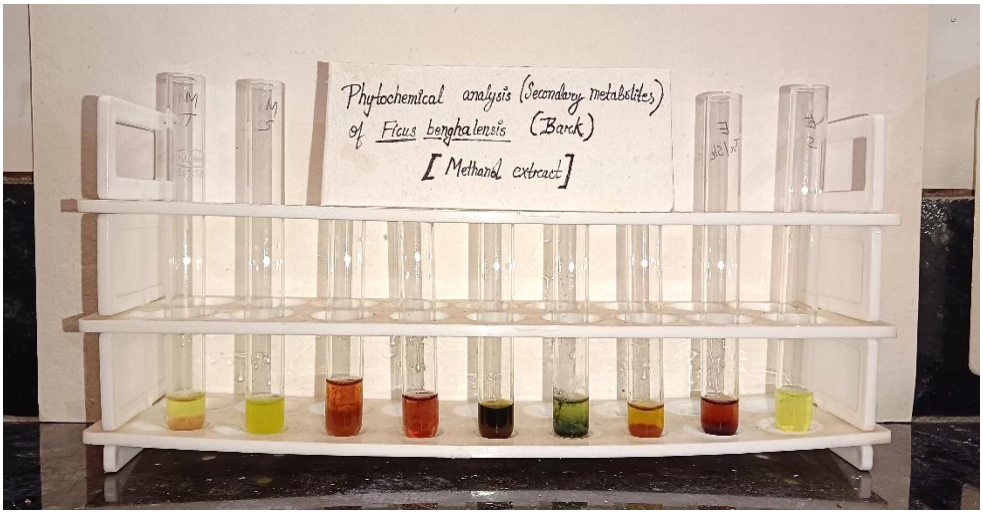


Figure 4: Phytochemical analysis (Secondary metabolites) of *F. benghalensis* (Bark) of ethanol extract

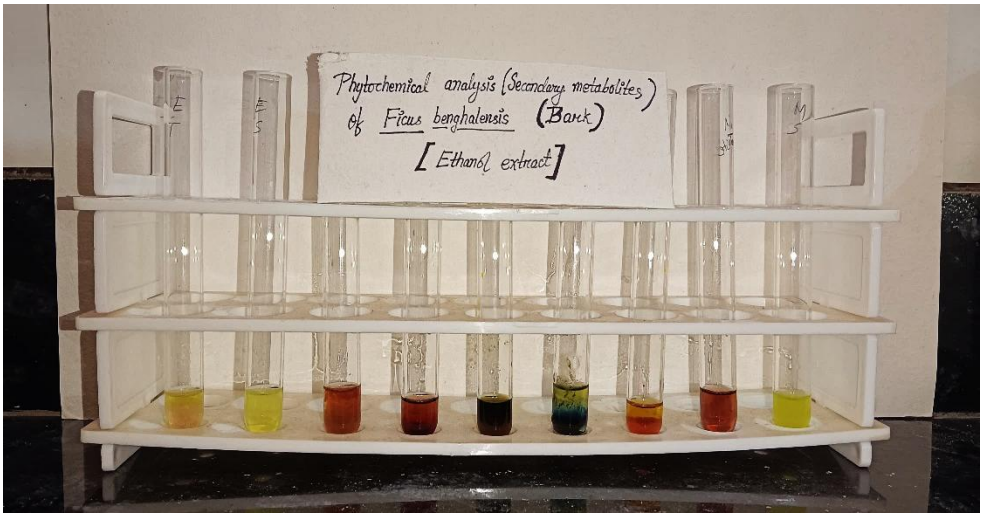


Figure 5: Phytochemical analysis (Secondary metabolites) of *F. benghalensis* (Bark) of ethanol extract

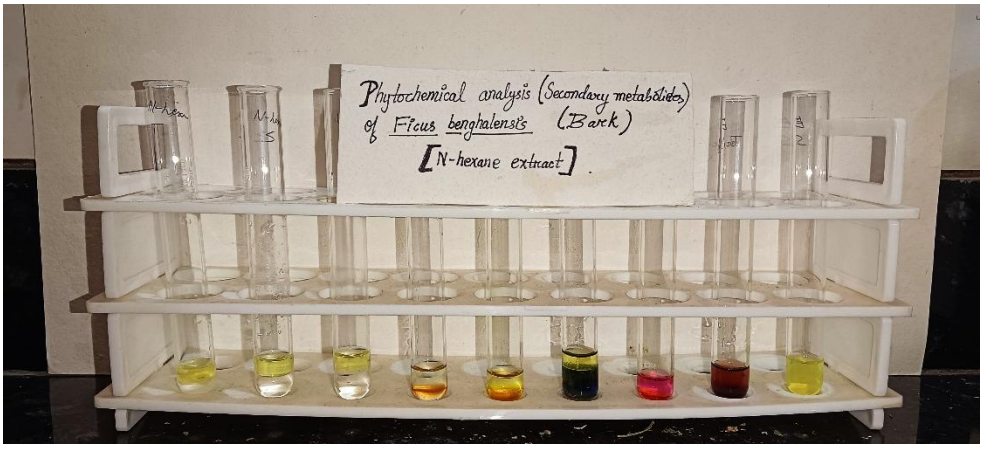


Figure 6: Phytochemical analysis (Secondary metabolites) of *F. benghalensis* (Bark) of n- hexane extract

ETHNOMEDICINAL USES

F. benghalensis has remarkable medicinal properties for treatment of multiple diseases. The ripened fruits of *F. benghalensis* are consumed in raw by local people as a form of tonic **(Figure 7)**. It is believed that latex is used for wound healing. Further, most of the plant parts such as leaves, bark, aerial root, fruit



and latex are used to treat piles, fever, rheumatism, inflammation, and wound healing **(Table 2)**.

Table 2: Ethnomedicinal uses of *F. benghalensis*

Parts used	Mode of uses	Diseases	Source
Aerial root	Decoction	Bleeding piles	Chaudhary et al., (2015)
Aerial root	Decoction	Jaundice	Singh et al., (2023)
Aerial root and leaf	Decoction	Fever	Chaudhary et al., (2015)
Bark	Decoction	Dysentery	Chaudhary et al., (2015); Patel and Gautam, (2014)
Buds and fruits	Decoction	Biliary complications	Singh et al., (2023)
Latex	Decoction	Rheumatism	Chaudhary et al., (2015)
Latex	Paste	Ulcer	Khaliq, (2017)
Latex	Decoction	Urinogenital disorders	Murugesu et al., (2021)
Leaves	Paste	Wound healing	Chaudhary et al., (2015)
Leaves	Decoction	Leucorrhoea	Murugesu et al., (2021)
Milky sap	Paste	Joint pain	Singh et al., (2023)
Ripen fruit	Raw	Immunity booster	Present study
Root	Decoction	Vomiting	Chaudhary et al., (2015)
Stem bark	Infusion	Diarrhoea	Singh et al., (2023)
Young stem	Raw	Toothache	Khaliq, (2017)



Figure 7: Tribal lady eating ripens fruit of *F. benghalensis*



PHARMACOLOGICAL ASPECTS

Pharmacological studies have corroborated many of these traditional claims, demonstrating its antidiabetic, anti-inflammatory, antioxidant, antimicrobial, anticancer, and would healing activities. Various parts of *F. benghalensis* (including roots, bark, leaves and fruits) seem to possess varied pharmacological activities, such as anti-diarrheal, anti-tumour, anti-allergic, anti-fungal, anti-pyretic, and antioxidant activities **(Table 3)**.

Table 3: Pharmacological activities of *F. benghalensis*

Parts used	Pharmacological values	Sources
Roots	Antidiarrheal activity	Tripathi and Sharma, (2016)
Stem bark	Antidiabetic activity	Khaliq, (2017); Dhungana et al., (2012)
Fruit	Anti-tumour activity	Tahir et al., (2023)
Bark	Anti-allergic activity and anti-stress activity	Chaudhary et al., (2015)
Aerial root	Anti- fungal activity	Gopukumar and Praseetha, (2015)
Root	Antipyretic activity	Dhungana et al., (2012)
Latex	Antioxidant activity	Yadav et al., (2011)
Aerial root	Immunomodulatory activity	Tripathi et al., (2015); Chaudhary et al., (2015)
Latex	Anti-inflammatory activity	Tripathi et al., (2015)
Bark	Antiatherogenic activity	Tripathi et al., (2015)



Aerial part and root	Anti-angiogenesis activity	Tahir et al., (2023)
Stem bark	Analgesic activity	Tripathi and Sharma, (2016); Dhungana et al., (2012)
Fruit	Antibacterial activity	Dhungana et al., (2012)
Bark	Antinociceptive	Rajdev et al., (2018)

ECOLOGICAL FACTORS

Beyond its profound cultural significance and recognized medicinal properties, *F. benghalensis*, the venerable Banyan tree, holds a pivotal role within diverse ecosystems across its native range. As a keystone species in many tropical and subtropical forests, its ecological contributions extend far beyond its imposing canopy, influencing biodiversity, nutrient cycling, and community structure. Ecologically, *F. benghalensis* plays a crucial role as a bedrock species, supporting diverse faunal communities and contributing significantly to biodiversity stability. It is consumed by birds and monkeys **(Gopukumar and Praseetha, 2015)**. For many avifaunal species, it is a shelter **(Figure 8)**. The unique growth habit as a hemi-epiphyte, its critical function as a prolific producer of figs that serve as a year-round food source for a wide array of frugivores, its complex obligate mutualism with fig wasps for pollination, and its role in providing habitat and support for numerous plant and animal species **(Noort, 2003; Kjellberg et al., 2022)**. Understanding the intricate ecological dynamics orchestrated by *F. benghalensis* is important in natural landscapes but also for informing conservation strategies that acknowledge its vital contribution to ecosystem health and resilience, especially in the face of ongoing environmental changes.



Figure 8: *F. benghalensis* is a home for many avifaunal species

CONCLUSION

Ficus benghalensis is a rich ethnomedicinal legacy, deeply embedded in ancient traditional knowledge, is increasingly validated by modern pharmacological investigations demonstrating a wide spectrum of bioactivities, including significant antioxidant, anti-inflammatory, antidiabetic, antimicrobial, and anticancer properties. These therapeutic potentials are strongly correlated with the diverse array of phytochemicals identified, particularly within its bark, such as reducing sugars, phenolic compounds, and tannins. Beyond its direct utility to human health, the Banyan tree plays a critical ecological role as a keystone species, supporting biodiversity through its unique growth habits, providing essential sustenance for frugivores, and engaging in intricate mutualistic relationships. The confluence of its established traditional efficacy, scientifically supported pharmacological actions, identified bioactive compounds, and vital ecological contributions firmly positions *Ficus benghalensis* as a valuable species for further research and sustainable utilization. Future work should focus on isolating specific lead compounds, elucidating precise mechanisms of action, conducting rigorous clinical trials, and developing conservation



strategies to ensure this remarkable species continues to benefit both human well-being and the ecosystem.

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