



CHAPTER 9

Exploring the pharmacological properties of *Ficus religiosa*: a phytochemical investigation

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Abstract: *Ficus religiosa*, commonly known as the sacred fig or peepal, has been traditionally utilized in various ethnomedical practices for its supposed therapeutic benefits. This phytochemical analysis aims to explore the pharmacological properties of *F. religiosa* bark by elucidating its key secondary metabolites. The chapter will involve the phytoconstituents, pharmacological, ethnomedicinal uses and ecological aspects. Subsequent pharmacological assays will be show potential biological activity, such as anti-inflammatory, antioxidant, antimicrobial, or antidiabetic effects. This chapter seeks to provide a scientific baseline for the traditional uses of *F. religiosa* and evaluate bioactive compounds present in bark for future drug development.

Keywords: Ethnomedicinal, ecological, pharmacological, phytochemical

INTRODUCTION

Medicinal plants have served as the foundation of healthcare systems for millennia across diverse cultures worldwide. From ancient civilizations to contemporary traditional practices, humanity has consistently relied on the vast biodiversity of the plant kingdom for therapeutic remedies. The World Health Organization (WHO) estimates that a significant portion of the global population still depends on traditional medicine, largely derived from plants,



for their primary healthcare needs (WHO, 2019). This enduring reliance highlights the rich ethnomedicinal knowledge passed down through generations, which often holds invaluable insights into the potential pharmacological activities of various plant species. The resurgence of interest in natural products is driven by several factors, including the escalating costs of conventional pharmaceuticals, the emergence of drug resistance in various pathogens, and a growing consumer preference for natural and holistic approaches to health (Ekor, 2014; Aware et al., 2022). This renewed focus has propelled scientific investigations into the traditional uses of medicinal plants, aiming to validate their efficacy, understand their mechanisms of action, and identify novel bioactive compounds for modern drug discovery.

Ficus religiosa, synonym is *Urostigma religiosum* (L.) Gasp. Ric. Caprifico (POWO, 2025). It is commonly known as the sacred fig, Peepal tree, or Bodhi tree, pipal, pipalo, aswatta, jori, usto is a species of fig native to the Indian subcontinent and Indochina. It holds profound cultural, religious, and spiritual significance in Hinduism, Buddhism, Jainism, and Sikhism, where it is revered as a sacred tree and often associated with enlightenment and spiritual awakening. It has several ancient holy texts, like Artha Sastra, Puranas, Upanishads, Ramayana, Mahabharata, Bhagavad Gita, and Buddhist literature (Verma, 2016). Beyond its symbolic importance, *F. religiosa* has been an integral part of traditional Indian medicinal systems, particularly Ayurveda, for centuries. Traditional texts and practices describe the therapeutic applications of various parts of *F. religiosa*, including its bark, leaves, fruits, and roots, for a wide spectrum of ailments. These traditional uses encompass treatments for inflammatory conditions, diabetes, skin disorders, respiratory issues (like asthma and cough), gastrointestinal problems (such as diarrhea and dysentery), and even neurological and reproductive disorders (Thakur et al., 2024). The extensive historical use and anecdotal evidence of its medicinal properties highlight its potential as a rich source of pharmacologically active compounds.

Preliminary phytochemical screenings of *F. religiosa* have revealed the presence of a diverse array of secondary metabolites, including flavonoids, tannins, phenolic compounds, steroids, triterpenoids, alkaloids, and glycosides (Rutuja et al., 2015). Many phytoconstituents are documented in all parts of plants, such as bark, leaves, fruits, and seeds. In bark, it contains phytosterols like lanosterol, β -sitosteryl-D-glucoside, bergapten, bergaptol



and stigmasterol. It also contains tannin, wax, saponin, leucocyanidin-3-O- β -D-glucopyranoside, leucopelargonidin-3-O- β -D-glucopyranoside, leucopelargonidin-3-O- α -L-rhamnopyranoside, lupeol, ceryl behenate, lupeol acetate, α -amyrin acetate, leucoanthocyanidin and leucoanthocyanin. In fruits, it contains flavonoids, namely kaempferol, quercetin, myricetin and amino acids, namely asparagine and tyrosine. Leaves contain campesterol, stigmasterol, isofucosterol, α -amyrin, lupeol, tannic acid, arginine, serine, aspartic acid, glycine, threonine, alanine. Seeds contain phytosterolin, β -sitosterol, glycoside, albuminoids (**Rutuja et al., 2015; Jyothisree and Umadevi, 2021**).

These natural compounds are widely recognized for their potent biological activities and are often responsible for the therapeutic effects attributed to medicinal plants. Indeed, modern pharmacological studies have begun to validate many of the traditional claims associated with *F. religiosa*. Research has demonstrated its potential in various areas, including antioxidant, anti-inflammatory, antimicrobial, antidiabetic, anti-ulcer, wound healing, hepatoprotective, nephroprotective, and even neuroprotective activities (**Devanesan et al., 2018**). Despite the extensive traditional use and emerging scientific validation, a comprehensive phytochemical investigation coupled with targeted pharmacological evaluation of isolated compounds from *F. religiosa* remains crucial. Many studies have focused on crude extracts, making it difficult to attribute specific pharmacological activities to individual chemical constituents or to understand their precise mechanisms of action. There is a need for a systematic approach to identify and characterize the specific bioactive molecules within *F. religiosa* bark that are responsible for its supposed medicinal properties. This chapter aims to bridge this knowledge gap by undertaking a phytochemical investigation of *Ficus religiosa* bark, followed by a rigorous evaluation of the pharmacological properties of its isolated compounds.

MORPHOLOGY

It is a large tree, epiphytic when young; all parts except the bracts are the glabrous; bark grey, smooth, irregularly pitted when old. Leaves more or less pendulous, broadly ovate, 13-27x 9-17 cm, margin often repand, very long-caudate, coriaceous, dark green and shining above, base cordate or tuncate with 3 strong principle nerves and 2-4 weaker ones, secondary nerves 8-10, looped within the margin, acumen many nerved; petiole slender, 4-11 cm



long; stipules linear subulate, 4.6-8 cm long. Figs axillary, germinate, sessile, depressed-globose, 1-2 cm diam., smooth, glabrous, dark purple when ripe, basal bracts 3, broad, rounded, spreading, ciliate or pubescent, 4-7 m long (**Saxena and Brahmam, 1995; Figure 1-3**).



Figure 1: Leaves of *F. religiosa*



Figure 2: Fruit of *F. religiosa*



Figure 3: Bark of *F. religiosa*

METHODOLOGY

The bark of *F. religiosa* was collected from the State Botanical Garden, Odisha, India. The plant species was identified by the authors. The Soxhlet extraction method was adopted using three solvents (N-hexane, ethanolic, and methanolic) for phytochemical analysis. Detection of nine secondary metabolites was conducted using standard methods (**Kumar et al, 2013; Marndi et al., 2024; Figure 4-7**).

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 dilute HCl were added. The colour initially turned to an intense yellow colour with NaOH solution and later became colourless. This colour changes 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 color 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 was added. The formation of yellow crystals confirmed the presence of carbonyl compounds.



Figure 4: Bark of *F. religiosa* sample for phytochemical analysis

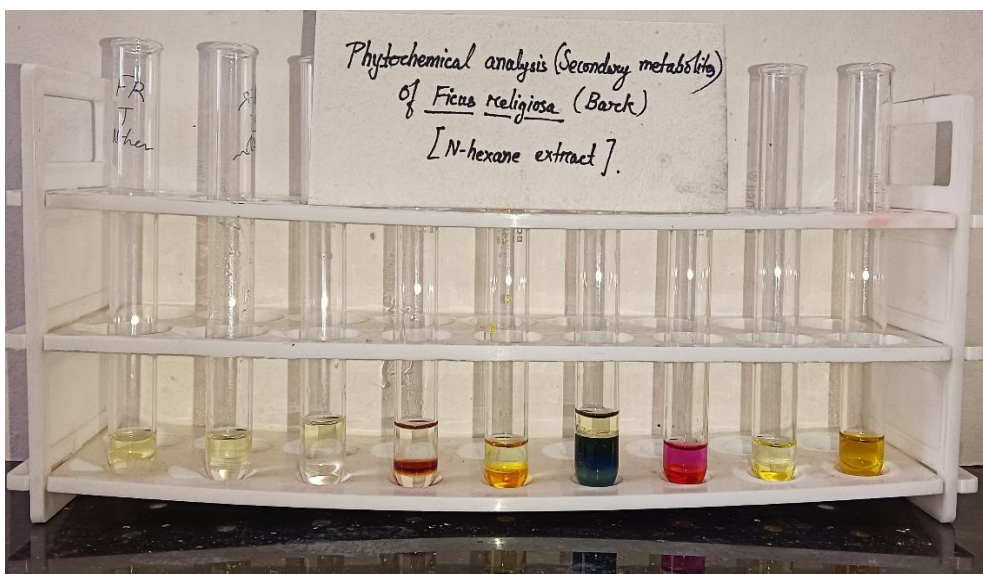


Figure 5: Phytochemical analysis (Secondary metabolites) of *F. religiosa* (Bark) of n- hexane extract

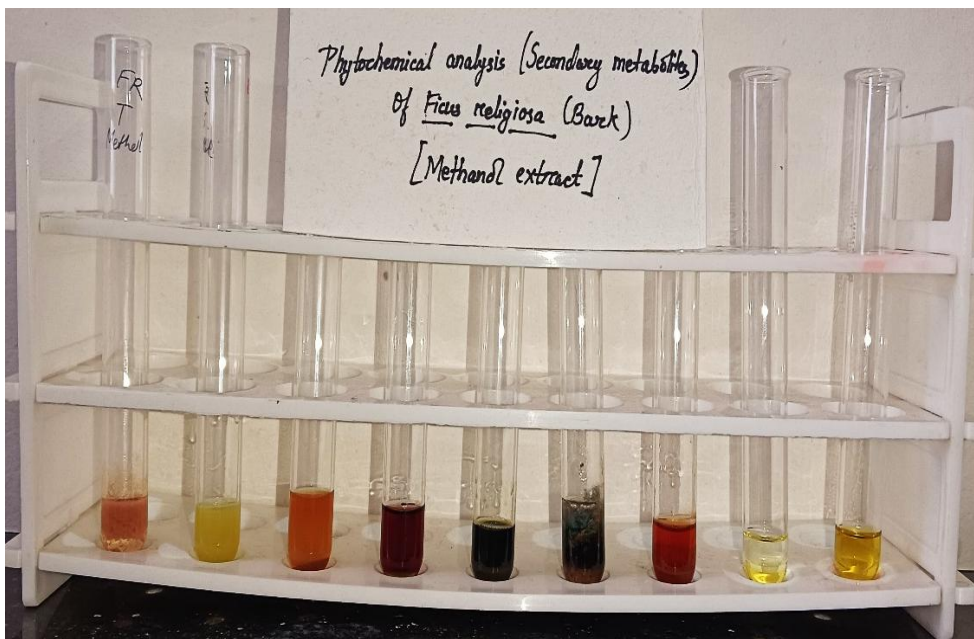


Figure 6: Phytochemical analysis (Secondary metabolites) of *F. religiosa* (Bark) of methanolic extract

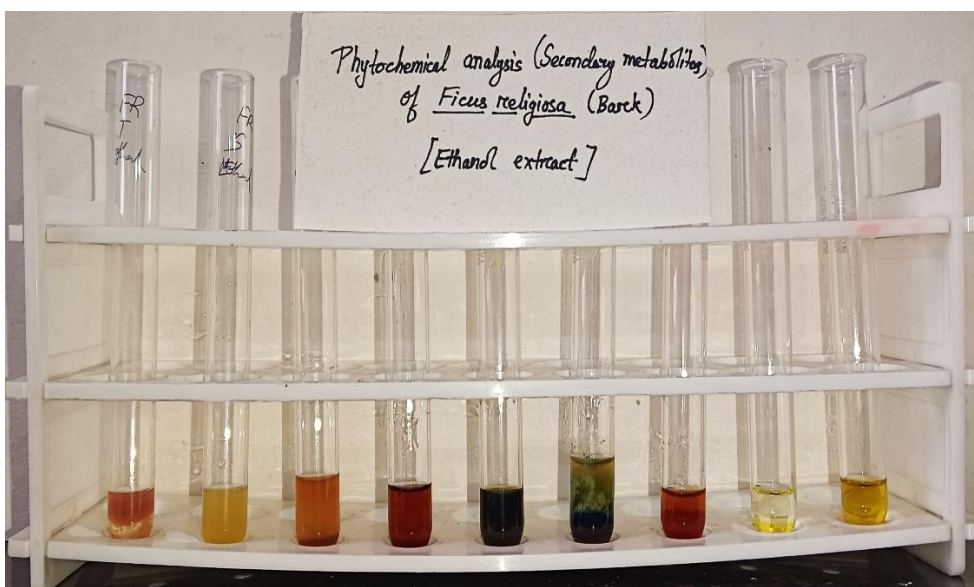


Figure 7: Phytochemical analysis (Secondary metabolites) of *F. religiosa* (Bark) of ethanolic extract



RESULTS AND DISCUSSION

During the field and literature survey it concluded that *F. religiosa* has abundant bioactive compounds in leaves, bark, stem, fig, latex, and root. According to researchers all parts has wide range of phytoconstituents are present which has significant role in pharmacological analysis. In Table 1, phytochemical analysis was conducted in different extracts of *F. religiosa* bark. As per Table 1, tannin, and alkaloids are present in methanolic and ethanolic extracts. Saponin and terpenoids are present in only methanolic extracts. Reducing sugars are present in all three extracts (**Figure 4-7; Table 1**).

Table 1: Phytochemical analysis using different extracts of *F. religiosa* bark

Bioactive compounds	N-hexane extract	Methanolic extract	Ethanolic extract
Tannin	-	+	+
Saponin	-	+	-
Flavonoids	-	-	-
Terpenoids	-	+	-
Phenolic compounds	-	-	-
Reducing sugars	+	+	+
Steroids	-	-	-
Alkaloids	-	+	+
Carbonyl compounds	-	-	-

Among the *Ficus* species one of the *Ficus* species are *Ficus religiosa* has abundant ethnomedicinal value in all over the India. Rendering to literature and field survey it concluded that all plants parts have ethnomedicinal values which used to cure many different ailments. According to Table 2, it concluded that all parts such as bark, fruit, latex, leaves, and roots have a



potential to cure different ailments such as diabetes, cuts, wounds, ulcer, skin infections, fever, astringent, inflammation, toothache etc. Mostly the mode of uses are decoction, paste, infusion, juice and powder (**Table 2**).

Table 2: Ethnomedicinal uses of *F. religiosa*

Plants parts	Mode of uses	Diseases	Sources
Bark	Decoction	Diabetes	Devi et al., (2022)
Bark	Paste	Burns	Hastir et al., (2021); Rutuja et al., (2015)
Bark	Infusion	Ulcer	Hastir et al., (2021)
Bark	Paste	Skin infections	Hastir et al., (2021); Shukla and Tiwari, (2023)
Bark	Decoction	Astringent	Shukla and Kansal, (2024)
Dried Fruit	Decoction	Fever	Rutuja et al., (2015)
Fruit	Powder	Asthma	Sandeep et al., (2018)
Latex	Paste	Inflammation	Rutuja et al., (2015)
Leaves	Juice	Toothache	Rutuja et al., (2015)
Leaves and shoots	Paste	Wound healing	Chowdhary et al., (2014)
Root	Powder	Seizures	Hastir et al., (2021)
Root	Paste	Elephantiasis	Hastir et al., (2021)
Stems	Decoction	Urinary disorders	Sandeep et al., (2018)
Tender leaves	Juice	Constipation	Kumar et al., (2022)



As per the literature survey it concluded that *F. religiosa* has wide array of pharmacological activities. In Table 3, all plant parts have significant pharmacological values. Most abundantly stem and bark possess analgesic activity, anti-inflammation, anti-acetylcholinesterase, antiulcer, etc (**Table 3**).

Table 3: Pharmacological values of *F. religiosa*

Plant Parts	Pharmacological activities	Sources
Bark	Antidiabetic activity	Pandit et al., (2010); Rutuja et al., (2015); Mahto et al., (2023)
Bark	Immunomodulatory activity	Rutuja et al., (2015)
Figs	Anticonvulsant activity	Shukla and Tiwari, (2023); Shukla and Kansal, (2024)
Figs	Anti-amnesic activity	Rutuja et al., (2015)
Leaves	Antimicrobial activity	Mahto et al., (2023)
Leaves	Wound healing activity	Chowdhary et al., (2014); Shukla and Kansal, (2024)
Stem bark	Analgesic activity	Rutuja et al., (2015); Shukla and Kansal, (2024)
Stem bark	Anti-inflammation activity	Rutuja et al., (2015); Shukla and Kansal, (2024)
Stem bark	Anti-acetylcholinesterase activity	Rutuja et al., (2015)
Stem bark	Antiulcer activity	Rutuja et al., (2015); Shukla and Kansal, (2024)
Stem bark, leaves	Antioxidant activity	Rutuja et al., (2015); Devanesan et al., (2018); Hastir et al., (2021); Shukla and Kansal, (2024)



ECOLOGICAL SIGNIFICANCE

Ficus religiosa is a lifeline for many avifaunal and faunal species. Unlike other species of *Ficus*, *F. religiosa* is a promising plant for ecological services. This designation stems from its ability to produce fruit year-round, even during periods of scarcity when other food sources are limited. These continuous fruiting cycles make *F. religiosa* a critical resource for a diverse range of frugivorous (fruit-eating) birds and mammals, effectively acting as a "lifeline" that sustains wildlife populations. The figs of *Ficus religiosa* are small, and ripen from green to purple. While they might appear modest, their abundance and consistent availability attract a remarkable variety of animals, creating a vibrant hub of ecological activity around the tree.

Birds play a crucial role as seed dispersers. A wide array of avian species are attracted to *F. religiosa* figs. Common frugivorous birds observed feeding on Peepal figs in India and other regions include: Mynas (e.g., Common Myna, Jungle Myna), Bulbuls (various species like Yellow-vented Bulbul), Doves (e.g., Blue-faced Dove, Lace-necked Dove), Parrots (e.g., Rose-ringed Parakeet), Hornbills (e.g., Great Hornbill), Barbets (e.g., Coppersmith Barbet), crows and Asian Koel (*Eudynamys scolopaceus*) (**Figure 8**) have also been noted (**Sharma et al., 2024; Gogoi et al., 2023**). Beyond birds, several mammalian species also rely on *F. religiosa* figs: Bats: Fruit bats are significant nocturnal frugivores that consume figs and disperse seeds over wide areas (**Aruna et al., 2009**). In wilder areas, even animals like deer, wild boar, and bears may be attracted to the ripe figs, particularly when they fall to the ground (**Shanahan et al., 2007**). The consumption of *F. religiosa* figs by these diverse faunal species is not merely a feeding event; it's a fundamental ecological process that underpins the health and resilience of tropical ecosystems. These trees act as ecological magnets, concentrating biodiversity and facilitating the vital process of seed dispersal, which is essential for maintaining forest structure and promoting regeneration, especially in disturbed or fragmented landscapes.



Figure 8: Asian Koel (*Eudynamys scolopaceus*) consuming fruit of *F. religiosa*

CONCLUSION

According to present scenario, phytochemical investigations have unequivocally demonstrated that *Ficus religiosa* is a rich repository of diverse bioactive compounds, including flavonoids, phenols, tannins, terpenoids, alkaloids, and glycosides. This intricate blend of secondary



metabolites underpins the plant's wide spectrum of pharmacological properties, such as antioxidant, anti-inflammatory, anti-diabetic, antimicrobial, wound healing, and hepatoprotective effects, among others. While traditional knowledge has long celebrated its medicinal virtues, modern scientific scrutiny continues to validate and elucidate the mechanisms behind these beneficial actions, solidifying *F. religiosa's* potential as a significant source for novel therapeutic agents and natural health remedies in future.

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