



ON OVERVIEW OF BIOACTIVE COMPOUNDS AND MEDICINAL ACTIVITY OF FICUS RELIGIOSA

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ABSTRACT

Ficus religiosa Linn. (Sacred fig), belonging to the family Moraceae, is a highly valued medicinal plant widely used in traditional systems of medicine, especially Ayurveda, Unani, and folk medicine. It is distributed throughout the Indian subcontinent and is renowned for its diverse therapeutic properties. Various parts of the plant, including leaves, bark, fruits, roots, flowers, and latex, are rich in bioactive phytoconstituents such as flavonoids, tannins, phenolics, alkaloids, glycosides, terpenoids, and sterols. These compounds are responsible for its broad spectrum of pharmacological activities including antioxidant, antimicrobial, anti-inflammatory, antidiabetic, anti-ulcer, wound healing, anticonvulsant, hepatoprotective, neuroprotective, and immunomodulatory effects. Among these, antimicrobial activity has gained significant attention due to its potential role in combating microbial infections and antimicrobial resistance.

This review comprehensively summarizes the botanical description, phytochemical composition, and pharmacological properties of *Ficus religiosa*, with special emphasis on its antimicrobial potential. The findings support its traditional uses and highlight the need for

further research on isolation of active constituents, mechanistic studies, and clinical validation to develop effective plant-based therapeutic agents.

KEYWORDS: *Ficus religiosa*, Sacred fig, Phytochemistry, Pharmacological activity, Anti-microbial activity, Medicinal plant.

INTRODUCTION

Over the past three decades, there has been a constant, and at times, exponential growth in global interest in the use of herbal medicines. This increase in popularity and usage of herbal medicines is evident in the global market. Herbal medicines, including finished herbal products and the starting materials for their production, such as medicinal plants, herbal materials, herbal preparations and herbal dosage forms, are moving into international commerce and global trade, which reflects their increased economic value and importance.^[1]

The Sacred fig, scientifically known as *Ficus religiosa* Linn., is one of the most revered, extensively studied, and pharmacologically significant medicinal trees of the Indian subcontinent. Belonging to the family Moraceae, Genus is *Ficus*, this large deciduous tree occupies a unique position at the intersection of botany, traditional medicine, religion, ecology, and modern pharmacological research. Their longevity is that they can live for several hundred years, latex: Milky latex present in all parts, Leaves are small figs (syconia), purplish when ripe.

Ficus religiosa is commonly known as Peepal tree, Ashvattha, Bodhi tree, or Pipal, Ravi chettu, pippala and is deeply embedded in ancient Indian civilization. It is not merely a botanical entity but a symbol of life, enlightenment, longevity, and healing, revered across Hinduism, Buddhism, and Jainism. From a scientific perspective, the plant has attracted increasing attention due to its rich phytochemical profile and wide spectrum of pharmacological activities, including antioxidant, antimicrobial, anti-inflammatory, antidiabetic, neuroprotective, cardioprotective, and anticancer effects. It can be used for the treatment of asthma, cough and other respiratory disorders. *Ficus* Linn being the largest genus of the family Moraceae comprises about 755 fig tree species worldwide. *F. religiosa* is a Bo tree, which sheltered the Buddha as he divined the “Truths.”

In Ancient Indian Literature the Sacred fig has been extensively described in ancient Indian texts such as: **Vedas, Upanishads, Ayurvedic Samhitas (Charaka, Sushruta), Puranas.**

The potential therapeutic benefits of leaf juice and fruits of *F. religiosa* have been documented in folk medicine. The leaf juice has been used for the treatment of asthma, cough, sexual disorders, diarrhoea, haematuria, earache and toothache, migraine, eye troubles, gastric problems and scabies; leaf decoction as an analgesic for toothache; stem bark in gonorrhea, bleeding, paralysis, diabetes, diarrhoea, bone fracture, as antiseptic, astringent and antidote. The leaves have been reported to have the hypoglycemic, Anticonvulsant, wound healing, anti-ulcer, anti-oxidant and immunomodulatory activity. Various constituents from leaves have been reported including carbohydrate, protein, lipid, lupeol campesterol, stigmasterol, and tannic acid. It improves complexion, heals wounds, burns, analgesic, anti-inflammatory. Bark: Useful in vomiting, diarrhoea and dysentery; Purgative.

This study aims to contribute to the scientific understanding of *Ficus religiosa* by focus on its phytochemical constituents and their correlation with observed with observed biological activities. Particularly antimicrobial, antioxidant, antiulcer, antidiabetic, anti-asthmatic and anticonvulsant properties. Every part of the plant including its leaves, stems, roots, seeds, and flowers has been documented for possessing distinct medicinal properties, making it a highly valued species in both ethnobotanical and phytochemical research.

TOXONOMICAL PROFILE

Table No. 1: (Sharma et al., 2016), (Singh and Jaiswal, 2014) and (Parasharami et al., 2014).^[3,4,5,6]

Domain	Eukaryota
Kingdom	Plantae
Subkingdom	Tracheobionta (Vascular plants)
Phylum	Tracheophyta
Subphylum	Euphyllipsida
Class	Magnoliopsida
Subclass	Dilleniidae
Order	Urticales
Family	Moraceae
Tribe	Ficeae
Genus	Ficus
Specific epithet	Religiosa Linnaeus

ORIGIN AND DISTRIBUTION

Ficus religiosa is native to the Indian subcontinent, mainly distributed in India, Nepal, Sri Lanka, Bangladesh, and Pakistan. It is widely cultivated and naturalized in tropical and subtropical regions of Asia, including Southeast Asia and southern China, and has also spread

to parts of the Middle East and Africa. The plant commonly grows in plains, along roadsides, riverbanks, and near temples, thriving well in warm climatic conditions.

MORPHOLOGICAL PROFILE

○ Habit and Habitat

Ficus religiosa is a large, perennial, deciduous to semi-evergreen tree, widely cultivated and naturally distributed throughout the Indian subcontinent, Sri Lanka, Nepal, Myanmar, Thailand, and parts of Southeast Asia. The tree is commonly found near temples, roadsides, riverbanks, and villages.

- Height: 20–30 m (may exceed 35 m under favourable conditions)
- Spread: Very wide canopy with extensive lateral branches
- Longevity: Extremely long-lived (often survives for several centuries)

○ Root System

- Type: Tap root system with extensive lateral roots
- Special Feature: Well-developed aerial adventitious roots, especially in older trees
- Function: Provide mechanical support, absorb moisture, and allow growth on rocky or masonry surfaces

○ Stem and Bark

- **Stem**
 - Strong, erect, cylindrical, woody trunk
 - Diameter may exceed 2–3 meters in mature trees
- **Bark**
 - Color: Grey to ash-brown
 - Texture: Smooth in young trees, becoming rough and fissured with age
 - Inner bark contains milky latex, characteristic of Moraceae

○ Leaves

- Arrangement: Alternate
- Type: Simple, petiolate

Leaf Morphology

- Shape: Broadly ovate to cordate (heart-shaped)
- Apex: Long, narrow, tapering caudate tip (drip-tip)

- Base: Deeply cordate
- Margin: Entire
- **Size**
 - Length: 10–18 cm ○ Width: 8–12 cm
- Venation: Reticulate, prominently visible
- Texture: Thin, glabrous, leathery
- **Colour**
 - Young leaves: Reddish-pink or copper
 - Mature leaves: Bright to dark green
- Petiole: Long, slender, 7–15 cm
- **Inflorescence and Flowers**
 - Inflorescence Type: Hypanthodium (syconium) – a specialized, enclosed inflorescence typical of *Ficus* species

Flowers

- Sexuality: Unisexual
- Distribution:
 - Male, female, and gall flowers occur inside the same syconium
- Perianth: Absent or reduced
- Stamens: Present in male flowers
- Ovary: Superior, single-chambered in female flowers
- Pollination: Obligatory entomophily, specifically by fig wasps (*Blastophaga* spp.)

○ **Fruit**

- Type: Syconus (fig)
- Shape: Globose to depressed-globose
- Size: 1–1.5 cm in diameter
- Colour: Immature: Green ○ Mature, Purplish-black
- Nature: Fleshy, containing numerous minute true fruits (achenes)
- Taste: Mildly sweet, slightly astringent

○ Seeds

- Number: Numerous
- Size: Very small
- Endosperm: Present
- Embryo: Straight
- Dispersal: Mainly by birds, bats, and other frugivorous animals

○ Latex

- Color: White, milky
- Occurrence: Present in stem, leaves, and fruits
- Significance: Protective role against herbivores and pathogens
- Nature: Sticky, rich in resins, enzymes, and secondary metabolites

○ Phenology

- Flowering: February to May
- Fruiting: May to August

CHEMICAL CONSTITUENT

The preliminary phytochemical analysis revealed that the plant contained tannins, phenols, saponins, sugars, alkaloids, methionine, terpenoids, flavonoids, glycosides and steroids.^[6-7]

The total phenol content present in one milligram of aqueous and ethanolic extracts of the bark was 497.77 and 375.23 μ g, respectively.^[8] The total phenolic contents of absolute ethanol, absolute methanol, aqueous ethanol (ethanol: water, 80:20 v/v) and aqueous methanol (methanol: water, 80:20 v/v) extracts was 3.13 ± 0.19 , 5.34 ± 0.36 , 2.67 ± 0.16 and 4.11 ± 0.18 (GAE g/100 g of DW) by shaking extraction technique and 2.12 ± 0.09 , 4.93 ± 0.28 , 2.26 ± 0.10 and 4.13 ± 0.21 (GAE g/100 g of DW) by reflux extraction technique respectively.^[9] However, chemical analysis showed that *Ficus religiosa* was rich in flavonoids, quercetin was most abundant 1.428 ± 0.5 - 4.29 ± 0.4 mg/Kg and myricetin was also present in good amounts 0.08 ± 0.3 - 1.0 ± 0.5 mg/kg.^[10]

○ BARK

The barks of *Ficus religiosa* contained bergapten, bergaptol, lanosterol, β sitosterol, stigmasterol, lupen-3-one, β -sitosterol-d-glucoside (phytosterolin), vitamin k1, tannin, wax, saponin, leucoanthocyanidin, leucoanthocyanin, leucocyanidin-3-0- β -Dglucopyrancoside,

leucopelargonidin- 3-O- β Dglucopyranoside, leucopelargonidin-3-O- α -L- rhamnopyranoside, lupeol, ceryl behenate, lupeol acetate and α -amyrin acetate.^[11-12]

○ FRUIT

Fruits contained protein 4.9%, amino acids, isoleucine, phenylalanine, asparagine, tyrosine, flavonols (kaempferol, quercetin, and myricetin), undecane, tridecane, tetradecane, (e)- β -ocimene, α - thujene, α -pinene, β -pinene, α -terpinene, limonene, dendrolasine, dendrolasine α -ylangene, α -copaene, β bourbonene, β -caryophyllene, α -trans bergamotene, aromadendrene, α humulene, alloaromadendrene, germacrene, bicyclogermacrene, γ -cadinene and δ -cadinene.^[13,14,15]

○ LEAVES

The major components of *Ficus religiosa* leaf oil were identified to be Eugenol (27.0%), Itaconic anhydride (15.4%), 3-Methylcyclopentane-1,2-dione (10.8%), 2Phenylethyl alcohol (8.0%), and Benzyl alcohol (4.2%). However, the leaf contained 44 compounds including (%): (3Z)-Hexenol 1.1, (2Z)-Hexenol 0.7, nHexanol 0.7, Phenol 0.7, Adipoin 0.6, 3Methylcyclopentane-1,2-dione 10.8, Itaconic anhydride 15.4, Benzyl alcohol 4.2, Salicylaldehyde 1.5, Phenylacetaldehyde 0.6, Allyl caproate 3.5, Linalool 0.3, n-Nonanal 0.3, 2- Phenylethyl alcohol 8.0, Benzeneacetonitrile 1.2, (2E,6Z)-Nonadienal 0.4, (2E) Nonen1-ol 0.5, (2E,6Z)-Nonadienol 0.5, (E)-Linalool oxide 0.5, Catechol 1.1, Coumaran 3.4, (E)Cinnamyl alcohol 0.6, p-Vinylguaiacol 1.1, (3Z)- Hexenyl tiglate 0.6, Eugenol 27.6, (2E) Hexenyl (3Z)-hexenoate 0.3, (E)- β -Ionone 1.6, Dihydroactinidiolide 0.4, α -Copaene-11ol 0.4, (3Z)-Hexenyl benzoate 0.5, epi γ Eudesmol 0.5, γ -Eudesmol 0.4, epi- α -Cadinol 1.0, β - Eudesmol 1.8, α Eudesmol 1.0, α -Cadinol 0.7, Pentadecanal 0.7, Palmitic acid 0.7 and Phytol 0.7%.^[16] Leaves also contained aspartic acid, glycine, threonine, alanine, proline, tryptophan, tyrosine, methionine, valine, isoleucine, leucine, nonacosane, hentricontanen, hexacosanol and noctacosan.^[17-18] HPLC analysis of the methanolic extract showed the presence of high amounts of serotonin (2.89%, w/w).^[19-20]

○ LATEX

A serine protease (religinosin) was purified from the decolorized latex of *Ficus religiosa*. It was a glycoprotein with a molecular mass of 43.4 kDa by MALDITO.

○ FLOWER

The flower of ***Ficus religiosa***, botanically described as a **syconium-type inflorescence**,

consists of numerous minute unisexual flowers enclosed within a hollow receptacle and is medicinally referred to as the flowering syconium. Phytochemical investigations of this floral structure have revealed the presence of **flavonoids** such as quercetin and kaempferol, **phenolic compounds** including gallic and ellagic acids, **tannins**, **plant sterols** like β -sitosterol, trace **triterpenoids** such as lupeol, and simple **sugars and glycosides**. These bioactive constituents collectively contribute to the pharmacological potential of the flower. Traditionally, the flowering syconium has been used in the management of **diarrhoea, dysentery, and bleeding disorders** due to its astringent and cooling properties, and as a **digestive tonic** in folk medicine. From a modern scientific perspective, the high phenolic and flavonoid content accounts for its **antioxidant and anti-inflammatory activities**, while tannins and phenolics impart **antimicrobial and gastroprotective effects**. Although less extensively studied than the bark or leaves, the flowers of *Ficus religiosa* play a supportive role in the plant's overall therapeutic profile and represent a **promising but underexplored source of bioactive compounds** for future pharmaceutical and nutraceutical applications.

○ ROOT

The **roots** of including both underground and aerial roots, are an important medicinal part widely used in traditional systems of medicine. Phytochemical studies have shown that the roots contain **flavonoids**, **phenolic compounds**, **tannins**, **triterpenoids** (such as lupeol and amyryns), **sterols** (β sitosterol), and minor amounts of **glycosides and carbohydrates**. These constituents are responsible for the roots' notable **antioxidant, anti-inflammatory, antimicrobial, and neuroprotective activities**. In Ayurveda and folk medicine, the roots are traditionally used in the treatment of **neurological disorders (including epilepsy and anxiety)**, **inflammatory conditions**, **urinary disorders**, **asthma**, and **skin diseases**, and are also considered useful in **diabetes management**. Modern pharmacological studies correlate these uses with the ability of root extracts to reduce oxidative stress, modulate inflammatory mediators, stabilize neuronal membranes, and inhibit microbial growth. Overall, the roots of *Ficus religiosa* contribute significantly to the plant's therapeutic value and represent a **pharmacologically relevant source of bioactive compounds**, supporting their continued use and further investigation in herbal and pharmaceutical research.

ACTIVITIES

1. Antioxidant Activity

- The plant shows significant free-radical scavenging and antioxidant effects in *in vitro*

assays such as DPPH, reducing power, and hydrogen peroxide scavenging.

- These effects are mainly attributed to phenolic compounds and flavonoids, which can protect cells from oxidative damage linked to chronic diseases.^[21]

2. Antidiabetic / Hypoglycemic Effects

- *Ficus religiosa* bark, leaf, and fruit extracts demonstrate blood glucose lowering effects in animal models, including normal and diabetic rats.
- Dose-dependent hypoglycemia was observed, with significant reduction in blood glucose levels in treated groups.^[22]

3. Anti-Inflammatory and Analgesic Activities

- Ethanolic extracts of leaves and stem bark reduce inflammation in carrageenan-induced paw edema models.
- The anti-inflammatory action likely involves inhibition of proinflammatory mediators (e.g., TNF- α , iNOS), supported by in-vitro and molecular docking studies.^[21]

4. Antimicrobial Activity

- Bark and leaf extracts exhibit inhibitory effects on bacterial and fungal strains, supporting traditional use in treating infections.
- This includes activity against gastrointestinal and skin pathogens, validating its ethnomedicinal antibacterial claims.^[24]

5. Anti-Ulcer Effects

- Alcoholic leaf extracts show anti-ulcerogenic action in water-immersion stress and other ulcer models.
- At doses up to 2000 mg/kg, no significant toxicity was observed, and histopathology confirmed mucosal protection.^[25]

6. Wound-Healing and Tissue Repair

- Extracts enhance wound closure, **increase collagen deposition**, and improve breaking strength in excision, incision, and dead space wound models.
- This suggests stimulation of tissue regeneration and antioxidant-mediated healing.^[26]

7. Anticonvulsant and Neuroprotective Effects

- Some studies report anticonvulsant activity in chemical and electroshock seizure models, indicating potential neuroprotective or CNS-modulating properties.^[27]

8. Analgesic (Pain-Relief) Action

- Both leaf and bark extracts show **analgesic effects** in standard pain models, comparable to some non-steroidal analgesics, likely due to inhibition of peripheral pain mediators.^[28]

9. Other Reported Effects

Scientific reviews and experimental studies also attribute the following activities to

F. religiosa:

- Immunomodulatory activity
- Antiasthmatic and bronchodilatory activity
- Anthelmintic and parasitocidal activity
- Antitumor / anticancer potential (apoptosis induction)
- Hepatoprotective effects
- Antianxiety and cognitive enhancement.^[29]

REVIEW ON FICUS RELIGIOSA BASED ON THE ACTIVITY^[30-45]

PLANT PART	EXTRACT TYPE	PHYTOCHEMICAL CONSTITUENTS	REPORTED ACTIVITIES/USES	FORMULATION
Leaves	Methanolic	Flavonoids (quercetin, kaempferol), phenolics, tannins	Antioxidant and freeradical scavenging activity	Capsules, tablets, syrups, antioxidant formulations
Leaves	Aqueous	Polyphenols, carbohydrates	Antidiabetic and hypoglycemic activity	Herbal teas, syrups, antidiabetic formulations
Leaves	Ethanolic	Flavonoids, sterols	Anxiolytic and cognitive enhancing activity	Capsules, tablets, neuro tonic formulations
Leaves	Hydroalcoholic	Phenolics, alkaloids	Anti-inflammatory and analgesic activity	Topical gels, pain relief formulations
Bark	Ethanolic	Tannins, saponins, β sitosterol, lupeol	Anti-diabetic and anti-hyperlipidemic activity	Tablets, capsules, lipid-lowering formulations
Bark	Aqueous	Glycosides, tannins	Anti-ulcer and gastroprotective activity	Syrups, oral liquid formulations
Bark	Methanolic	Phenolics, flavonoids	Hepatoprotective activity against CCl_4 induced toxicity	liver-protective capsules, syrups
Fruits	Methanolic	Flavonoids, phenolic acids	Antioxidant and anti-inflammatory activity	Nutraceutical capsules, antioxidant formulations
Fruits	Aqueous	Sugars, phenolics	Mild laxative and digestive aid	Digestive tonics, syrups
Seeds	Ethanolic	Fixed oils, proteins,	Antimicrobial activity	Ointments, creams,

		sterols	against Gram-positive and Gram-negative bacteria	antimicrobial formulations
Latex	Chloroform	Proteolytic enzymes, resins	Wound healing and anti-inflammatory activity	Ointments, gels wound-healing
Latex	Methanolic	Terpenoids, phenolics	Analgesic and antimicrobial activity	Gels, creams topical pain-relief
Roots	Methanolic	Alkaloids, tannins	Anti-inflammatory activity	Capsules, tablets, anti-inflammatory formulations
Whole plant	Green synthesis extract	Polyphenols, flavonoids	Green synthesis of silver nanoparticles with antimicrobial activity	Nano-formulations, antimicrobial coatings
Leaves	Ethanolic	Flavonoids, phenolics	Anticonvulsant and neuroprotective activity	Neuroprotective capsules, syrups

CONCLUSION

Based on the critical review of available literature, the present study highlights the significant potential of *Ficus religiosa* as a valuable source of plant-based phytoconstituents for skincare applications. Various bioactive compounds present in *Ficus religiosa*, including flavonoids, alkaloids, tannins, saponins, phenolics, and terpenoids, have been widely reported to exhibit antimicrobial, antioxidant, anti-inflammatory, wound-healing, and moisturizing properties, making this plant highly suitable for topical formulations.

In conclusion, this review consolidates existing knowledge on plant-derived phytoconstituents from *Ficus religiosa* relevant to skincare and supports the concept of developing herbal cream formulations as a future research direction. Further experimental, formulation, and clinical studies are necessary to translate these findings into effective and commercially viable topical products.

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