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Taxonomy, phytochemical composition and pharmacological prospectus of *Ficus religiosa* linn. (Moraceae)- A review

Chitra Gupta^{*1}, Shipra Singh¹

1. Department of Pharmaceutical Sciences, M.J.P. Rohilkhand University, Bareilly, india-243006

[Email: myswtdunia@gmail.com]

Abstract: *Ficus religiosa* Linn is a large perennial tree found throughout India. It is used traditionally in the treatment of asthma, diabetes, epilepsy, cancer, hyperlipidemia, inflammatory disorders, and infectious disorders. The present work is an attempt to compile an up-to-date and comprehensive review of *F. religiosa* that covers its Taxonomy, phytochemistry and pharmacological study.

Keywords: *Ficus religiosa*, pharmacological activities, Antibacterial, antidiabetic, antiulcer.

Introduction: Plants have played a significant role in maintaining human health and improving the quality of human life for thousands of years and have served humans well as valuable components of medicines, seasonings, beverages, cosmetics and dyes. Herbal medicine is based on the premise that plants contain natural substances that can promote health and alleviate illness.

The history of herbal medicine is as old as human civilization.^{1,2} There are more than 800 species and 2000 varieties of *Ficus* genus, most of which are native to old world tropics. *Ficus benghalensis* (Banyan tree), *FicusReligiosa* (Pipal tree) and *Ficus carica* (Anjir tree) are some of the commonly occurring trees of this genus belonging to family Moraceae.^{3, 4, 5}

Ficus religiosa Linn (Moraceae) commonly known as 'Peepal tree' is a large widely branched tree with leathery, heart shaped long tipped leaves on long slender petioles and purple fruits growing in pairs. The tree is regarded as a sacred tree to both Hindus as well as Buddhists.⁶ It found throughout the plains of India upto 170m altitude in the Himalayas, largely planted as an avenue and roadside tree especially near temples.⁷ It is the oldest portrayed tree in India.¹⁴ The plants have been used in traditional Indian medicine for various ranges of ailments. Traditionally the bark is used as an antibacterial, antiprotozoal, antiviral, astringent, antidiarrhoeal, in the treatment of gonorrhoea, ulcers, and the leaves used for skin diseases. The leaves reported antivenom activity and regulates the menstrual cycle.^{8, 9} It also has been used in the treatment of various diseases such as cancer, inflammation, or infectious diseases and high fever.¹⁰ Fruits are used as laxatives, latex is used as a tonic, and fruit powder is used to treat asthma.^{11, 12, 13}

BOTANICAL DESCRIPTION:

TAXONOMY:

Taxonomy of the plant is given in table no.1

| | |
|------------------|------------------------|
| Domain | Eukaryota |
| Kingdom | Plantae |
| Subkingdom | Viridiaeplantae |
| Phylum | Tracheophyta |
| Subphylum | Euphyllophytina |
| Class | Magnoliopsida |
| Subclass | Dilleniidae |
| Order | Urticales |
| Family | Moraceae |
| Tribe | Ficeae |
| Genus | Ficus |
| Specific epithet | Religiosa Linnaeus |
| Botanical name | <i>Ficus religiosa</i> |

VERNACULAR NAMES:

Vernacular name of the plant is given in table no. 2

| | |
|----------|------------------------------------|
| Hindi | Pipal, Pipala |
| English | Pipal tree |
| Sanskrit | Pippala |
| Assamese | Ahant |
| Bengali | Asvattha, Ashud, Ashvattha |
| Gujrati | Piplo, Jari, Piparo, Pipalo |
| Kannada | Arlo, Ranji, Basri, Ashvatthanara, |

| | |
|-----------|--|
| | Ashwatha |
| Kashmiri | Bad |
| Malayalam | Arayal |
| Marathi | Pipal, Pimpal, Pippal |
| Oriya | Aswatha |
| Punjabi | Pipal, Pippal |
| Tamil | Ashwarthan, Arasamaram, Arasan, Arasu, Arara |
| Telugu | Ravichettu |

Morphology:

F. religiosa is a large, deciduous tree up to 35m height. It has a heart shaped leaves. It shed its leaves in the month of March and April. The purple fruits of the Peepal are hidden with the figs. It is one of the longest living trees.^{15, 16} The bark is flat or slightly curved, varying from 5 to 8 mm in thickness, outer surface is grey or ash with thin or membranous flakes and is often covered with crustose lichen brown or ash coloured, surface has shallow irregular vertical fissures and uneven due to exfoliation of cork, inner surface smooth, yellowish to orange brown and fibrous.^{17, 18}

MICROSCOPY:

Leaves that are dark green in color 10–18×7.5–10 cm, ovate-rotund, narrow upward and the apex produces into a linear-lanceolate tail about half of the main portion of the blade, base broadly cuneate to cordate, margin entire or undulate; secondary veins five to seven on each side of the midvein, lateral veins eight pair with finely reticulate venation petioles 7.5–10cm long, slender; stipules minute ovate, acute. Figs axillary on leafy branchlets, paired or solitary, red when mature, globose to depressed globose, 1–1.5cm in diameter, smooth; peduncle 4–5mm; involucre bracts ovate. Male, gall (sterile female) and female flowers occur within the same fig. Male flowers: few, near apical pore, sessile; calyx 2–3-lobed, margin revolute; stamen 1; filament short. Gall flowers: pedicellate; calyx 3–4-lobed; ovary globose, smooth; style short; stigma enlarged, 2-lobed. Female flowers: sessile; calyx 4-lobed, broadly lanceolate; ovary globose, smooth; style thin; stigma narrow.^{19, 20, 21} The bark (Fig. 1F) is flat or slightly curved with thin or membranous flakes, often covered with crustose lichen patches. The outer bark is grayish or ash-colored, exfoliated with

irregular rounded flakes of 2–2.5cm thickness.²

PHYTOCHEMICAL CONSTITUENTS:

Preliminary phytochemical screening of *F. religiosa* barks, showed the presence tannins, saponins, flavonoids, steroids, terpenoids and cardiac glycosides.^{29, 30}

Constituents of the bark:

Phytosterols like, lanosterol, β -sitosteryl-D-glucoside, bergapten, bergaptol and stigmasterol have been isolated from the petroleum ether and alcoholic extracts of the bark of *F. religiosa* (Figure: 1).^{23, 24, 25} The bark of *F. religiosa* comprises around 8.7% of total tannin content.²⁶ Phenolic components, acid detergent fiber (ADF), neutral detergent fiber (NDF), acid detergent lignin (ADL) and saponins have been identified in the inner bark of *F. religiosa*.²⁷ The bark also contains tannin, wax, saponin, leucocyanidin-3-O- β -D-glucopyranoside, leucopelargonidin- 3-O- β -Dglucopyranoside, leucopelargonidin-3-O- α -L-rhamnopyranoside, lupeol, ceryl behenate, lupeol acetate, α -amyrin acetate, leucoanthocyanidin and leucoanthocyanin.³¹

Constituents of the fruits:

Asparagine and tyrosine are the most abundant amino acids of the fruit pulp of *F. religiosa*.²⁸ *F. religiosa* fruits contain a considerable amount of flavonoids namely kaempferol, quercetin, and myricetin and other phenolic components.²⁷

Constituents of the leaves:

Leaves yield campesterol, stigmasterol, isofucoesterol, α -amyrin, lupeol, tannic acid, arginine, serine, aspartic acid, glycine, threonine, alanine, proline, tryptophan, tyrosine, methionine, valine, isoleucine, leucine, nonacosane, n-hentricontanen, hexa-cosanol and n-octacosan.^{32- 34}

Constituents of the seeds:

The seeds contain phytosterolin, β -sitosterol, and its glycoside, albuminoids, carbohydrate, fatty matter, coloring matter, caoutchou 0.7–5.1%.^{32- 34}

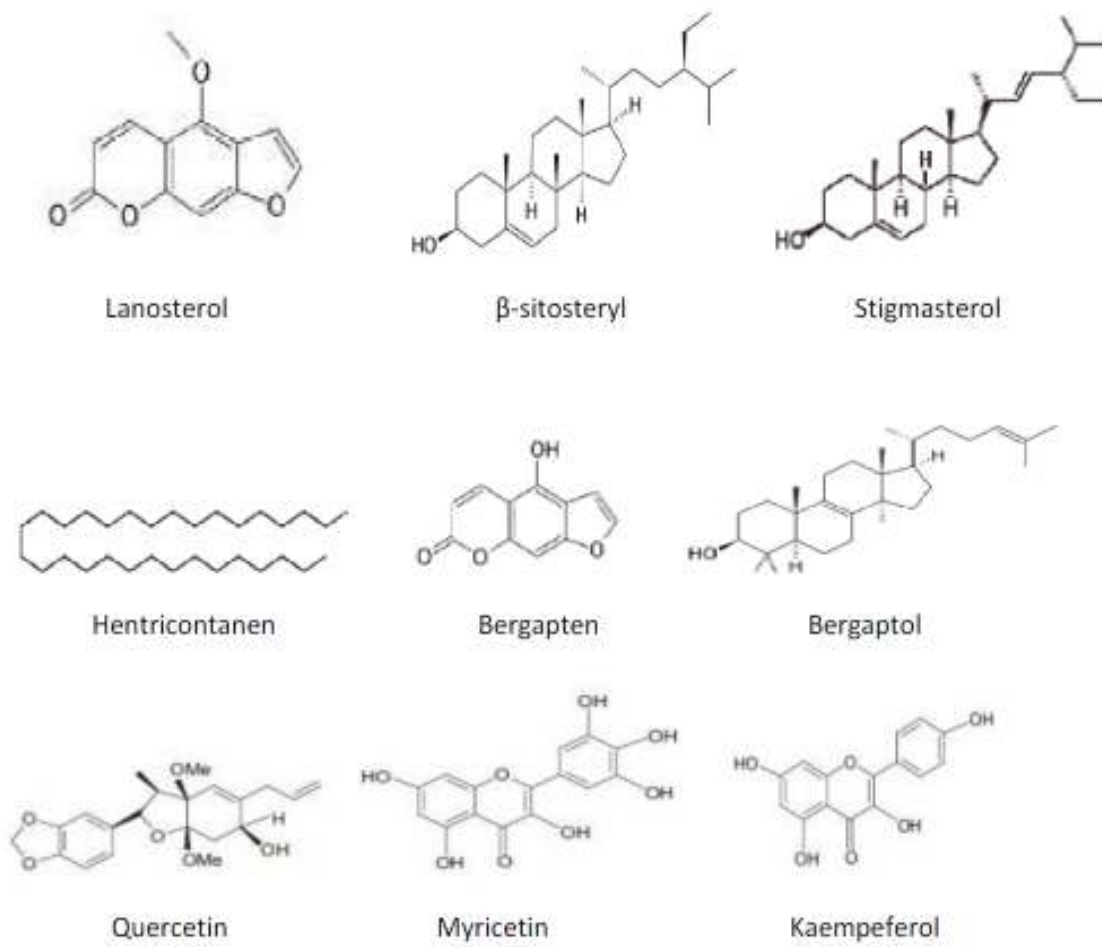


Figure: 1 Structure of the Phytoconstituents

PHARMACOLOGY:**Hypoglycemic activity**

Oral administration of *F. religiosa* bark extract at the doses of 25, 50, and 100mg/kg was studied in normal, glucose-loaded, and STZ (streptozotocin) diabetic rats. The three doses of bark extract produced significant reduction in blood glucose levels in all the models. The effect was more pronounced in 50 and 10mg/kg than 25mg/kg. *F. religiosa* also showed significant increase in serum insulin, body weight, and glycogen content in liver and skeletal muscle of STZ-induced diabetic rats, while there was significant reduction in the levels of serum triglyceride and total cholesterol. *F. religiosa* also showed significant antilipid peroxidative effect in the pancreas of STZ-induced diabetic rats. The results indicate that aqueous extract of *F. religiosa* bark possesses significant antidiabetic activity.³⁵

Hypolipidemic activity:

Dietary fiber content of food namely peepalbanti (*F. religiosa*), cellulose, and lignin were predominating constituents in peepalbanti, fed at 10% dietary level to rats, induced a greater resistance to hyperlipidemia than cellulose. Teent had the

most pronounced hypocholesterolemic effect that appeared to operate through increased fecal excretion of cholesterol as well as bile acids. Dietary hemicellulose showed a significant negative correlation with serum and liver cholesterol and a significant positive correlation with fecal bile acids. The dietary fiber influenced total lipids, cholesterol, triglycerides, and phospholipids of the liver to varying extents.³⁶

Anti-inflammatory and analgesic activities:

The anti-inflammatory and analgesic effect of the stem-bark methanolic extract of *F. religiosa* studied by Sreelekshmi et al. Anti-inflammatory activity was evaluated using carrageenan-induced paw edema and analgesic activity by acetic acid-induced writhing test. Treatment with the extract (125, 250 and 500 mg/kg; p.o.) decreased the paw volume and number of writhings in carrageenan-induced paw edema and acetic acid-induced writhing test, respectively. Anti-inflammatory and analgesic effect of the extract at 250 mg/kg dose was found to be equipotent to indomethacin (5 mg/kg) and aspirin (100 mg/kg).³⁷

In another investigation, the anti-inflammatory effect of the aqueous bark extract was investigated in acute and chronic models of inflammation. Carrageenan-induced paw edema test served as acute, and cotton pellet-induced granuloma test as chronic inflammation model. Treatment with the extract at 25, 50 and 100 mg/kg doses decreased the paw volume in carrageenan test, and at 50, 100 and 200 mg/kg prevented the increase in weight of granulomatous tissue in cotton pellet test.³⁸

Antimicrobial and antiviral activities:

The antibacterial effect of the aqueous and ethanolic bark extracts of *F. religiosa* against *Pseudomonas aeruginosa*, *Pseudomonas testosteroni*, *Proteus mirabilis*, *Proteus vulgaris*, *Enterobacter aerogenes*, *Escherichia coli*, *Citrobacter freundii*, *Staphylococcus epidermidis*, *B. cereus*, *Streptococcus fecalis*, *Streptococcus cremoris* and *Streptococcus agalactiae* studied by Nair and Chanda. The aqueous extract was found to be ineffective, while the ethanolic extract inhibited the growth of two tested bacterial strains. Another study by the same research group reinvestigated the antibacterial effect of the aqueous and ethanolic bark extracts against *P.*

aeruginosa, *P. mirabilis*, *Staphylococcus aureus*, *B. cereus*, *Alcaligenes faecalis* and *Salmonella typhimurium*. The aqueous extract showed a weak antibacterial activity against *B. cereus*. The ethanolic extract was found to be ineffective against *P. aeruginosa*, but inhibited the growth of all other tested strains.³⁹

Investigated the antibacterial effect of the ethanolic leaf extract of *F. religiosa* along with 65 other Indian medicinal herbs against nine bacterial strains was done by Aqil and Ahmad. The leaf extract inhibited the growth of six bacterial strains.⁴⁰

The antibacterial effect of the aqueous, ethanolic and methanolic leaf extracts of *F. religiosa* was investigated against *Bacillus subtilis*, *P. aeruginosa*, *E. coli* and *Salmonella typhi*. The aqueous extract showed maximum activity followed by methanolic and ethanolic extracts.⁴¹

In an *in vitro* study, the ethanolic, methanolic and aqueous leaf extracts of *F. religiosa* exhibited inhibitory effect on methanogenesis caused by methanogens (methane producing microorganisms).⁴² The extracts of *F. religiosa* has also been found to be effective against oral bacteria.⁴³

Wound healing activity:

Wound healing activity of the hydro-alcoholic leaf extract of *F. religiosa* has been investigated in rats. Leaf powder was extracted with 70% hydro-alcoholic solvent, dried under reduced pressure to get a semisolid extract (yield 32.5%, w/w). Phytochemical screening showed the presence of glycosides and tannins in the extract. The activity of the extract was determined using excision and incision rat wound models. Treatment with 5 and 10% extract ointment promoted the healing of wound in a dose-dependent manner, indicated by increased rate of wound contraction, decrease in the period for epithelialisation and high skin breaking strength.⁴⁴ A similar study proving the wound healing effect of the hydro-alcoholic leaf extract has also been reported.⁴⁵ The stem-bark of *F. religiosa* has been evaluated for its wound healing activity in combination with other herbs as a polyherbal formulation.⁴⁶

Anticonvulsant activity:

The effect of *F. religiosa* leaves was investigated in the pentylenetetrazol (PTZ)-induced convulsion model. The animals

pretreated with the leaf extract 30 min prior to PTZ (60 mg/kg; i.p.) exhibited 80–100% seizures protection.⁴⁷

Antioxidant activity:

The antioxidant activity of the aqueous extract of *F. religiosa* was investigated in streptozotocin-induced diabetic rats. Since the oxidative stress is the major cause and consequence of type 2 diabetes.⁴⁸

Investigation of the in vitro antioxidant effect of the ethylacetate root extract of *F. religiosa* using diphenylpicryl-hydrazyl (DPPH) radical scavenging, hydroxyl radical scavenging, reducing capacity and hydrogen peroxide scavenging assay was done by Sharma and Gupta. The extract showed reducing potential, scavenged DPPH radical (87.61%) at 250g/ml and hydrogen peroxide (70.25%) at 1000g/ml.⁴⁹

Antiasthmatic activity:

The alcoholic bark extract at 300, 375, 450 mg/kg; i.p. and 75 mg/kg; i.v. doses inhibited the experimental asthma induced by 5% acetylcholine aerosol in guinea pig. The extract treatment also prevented the asthma induced by 1.5% histamine aerosol at a dose of 450 mg/kg; i.p. The extract

exhibited more pronounced effect against asthma induced by acetylcholine as compared to histamine, suggesting strong involvement of parasympatholytic and weak antihistaminic mechanisms. Moreover the bark extract showed relaxation of the bronchial muscles of dog when injected at 35–70 mg/kg; i.v. dose. The study proved the bronchodilatory effect of the bark and validated its traditional use in asthma.⁵⁰

Immunomodulatory activity:

The immunomodulatory effect of alcoholic extract of the bark of *F. religiosa* (moraceae) was investigated in mice. The study was carried out by various hematological and serological tests. Administration of extract remarkably ameliorated both cellular and humoral antibody response. It is concluded that the extract possessed promising immunostimulant properties.⁵¹

Anti-ulcer activity:

The anti-ulcer activity was investigated using ethanol extract of stem bark of *F. religiosa* against in vivo indomethacin- and cold restrained stress-induced gastric ulcer, and pylorus ligation assays.⁵²

Anticancer activity:

Powdered bark 1–3 g or its liquid extract 60–120ml of *F. religiosa* exhibited antitumor activity.⁵³

Anti-acetylcholinestrase activity:

Methanolic extract of the stem bark of *F. religiosa* found to inhibit the acetylcholinestrase enzyme, thereby prolonging the half-life of acetylcholine. It was reported that most accepted strategies in alzheimer's diseases treatment is the use of cholinestrase inhibitors. The calculated 50% inhibitory dose (ID50) value was 73.69µg/ml respectively. The results confirm and justify the popular traditional use of this plant for the treatment of alzheimer's disease.⁵⁴

CONCLUSION:

The present review describes the morphological, phytochemical and pharmacology aspects of *Ficus Religiosa* (Moraceae). *F. religiosa* is a good source of traditional medicine for the treatment of asthma, diabetes, epilepsy, cancer, hyperlipidemia, inflammatory disorders, infectious disorders etc. Most of the mentioned pharmacological studies were aimed on validating its traditional uses. The medicinal value of this plant in the treatment

of a large number of human ailments is mentioned in Ayurveda, Charaka Samhita, and Sushrita Samhita.

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