

Phytopharmacology of *Ficus religiosa*

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ABSTRACT

Herbs have always been the principal form of medicine in India. Medicinal plants have curative properties due to the presence of various complex chemical substances of different composition, which are found as secondary plant metabolites in one or more parts of these plants. *Ficus religiosa* (L.), commonly known as peepal belonging to the family Moraceae, is used traditionally as antiulcer, antibacterial, antidiabetic, in the treatment of gonorrhoea and skin diseases. *F. religiosa* is a Bo tree, which sheltered the Buddha as he divined the "Truths." The present review aims to update information on its phytochemistry and pharmacological activities.

Key words: Antibacterial, antidiabetic, antiulcer, *ficus religiosa* (L.), pharmacological activities, phytochemistry

INTRODUCTION

Ficus religiosa (L.) is a large perennial tree, glabrous when young, found throughout the plains of India upto 170m altitude in the Himalayas, largely planted as an avenue and roadside tree especially near temples.^[1] It is a popular bodhi tree and has got mythological, religious, and medicinal importance in Indian culture since times immemorial.^[2] The plants have been used in traditional Indian medicine for various range 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.^[3,4] In Bangladesh, it has been used in the treatment of various diseases such as cancer, inflammation, or infectious diseases.^[5] In case of high fever, its tender branches are used as a toothbrush. Fruits are used as laxatives,^[6] latex is used as a tonic, and fruit powder is used to treat asthma.^[7,8]

BOTANICAL DESCRIPTION

Taxonomy

Domain: Eukaryota
Kingdom: Plantae
Subkingdom: Viridiplantae
Phylum: Tracheophyta
Subphylum: Euphyllophytina

Infraphylum: Radiatopses
Class: Magnoliopsida
Subclass: Dilleniidae
Superorder: Urticales
Order: Urticales
Family: Moraceae
Tribe: Ficeae
Genus: *Ficus*
Specific epithet: *Religiosa Linnaeus*
Botanical name : *Ficus religiosa*

Vernacular names

Sanskrit: Pippala
Assamese: Ahant
Bengali: Asvattha, Ashud, Ashvattha
English: Pipal tree
Gujrati: Piplo, Jari, Piparo, Pipalo
Hindi: Pipala, Pipal
Kannada: Arlo, Ranji, Basri, Ashvatthanara, Ashwatha, Aralimara, Araleghida, Ashvathamara, Basari, Ashvattha
Kashmiri: Bad
Malayalam: Arayal
Marathi: Pipal, Pimpal, Pippal
Oriya: Aswatha
Punjabi: Pipal, Pippal
Tamil: Ashwarthan, Arasamaram, Arasan, Arasu, Arara
Telugu: Ravichettu

Morphological characters

This big and old tree is of 30m long. They shatter bark and are of white or brown in color. The leaves are shiny, thin, and bear 5–7 veins. Fruits are small, about ½ inch in diameter, similar to that of eye pupil. It is circular in shape and compressed. When it is raw, it is of green color and turns black when it is ripe. The

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tree fruits in summer and the fruits get ripened by rainy season.

The leaves show more or less sigmoid growth pattern, each leaf increases in size in 9 days from about 425 to 4025mm² (as judged by the average mature leaf size) after its emergence from the spathe. The leaf is hypostomatic and has paracytic and anomocytic stomata between polygonal epidermal cells. The frequency of stomata per square millimeter increases from 33.3 to 400 per mm² with the growth of the leaves, while the number of upper epidermal cells decreases from 5600 to 1110. The vasculature comprises a single main vein (the midrib), secondaries, tertiaries, quaternaries, and intermediaries. The number of areoles per square millimeter decreases from 15.5 to 2.7, while the number of vein endings and vein tips per areole show no correlation either with one another or with leaf size.^[9]

PHYTOCHEMISTRY

The stem bark of *F. religiosa* are reported phytoconstituents of phenols, tannins, steroids, alkaloids and flavonoids, β -sitosterol-D-glucoside, vitamin K, n-octacosanol, methyl oleanolate, lanosterol, stigmaterol, lupen-3-one.^[10] The active constituent from the root bark *F. religiosa* was found to be β -sitosterol-D-glucoside, which showed a peroral hypoglycemic effect in fasting and alloxan-diabetic rabbits and in pituitary-diabetic rats. The fruits contain 4.9% protein having the essential amino acids, isoleucine, and phenylalanine.^[11] The seeds contain phytosterol, β -sitosterol, and its glycoside, albuminoids, carbohydrate, fatty matter, coloring matter, caoutchoue 0.7–5.1%.^[12] *F. religiosa* fruits contain flavonols namely kaempferol, quercetin, and myricetin.^[13] Leaves and fruits contain carbohydrate, protein, lipid, calcium, sodium, potassium, and phosphorus.^[14] The aqueous extract of dried bark of *F. religiosa* has been reported to contain phytosterols, flavonoids, tannins, furanocoumarin derivatives namely bergapten and begaptol [Figure 1].

The fruit of *F. religiosa* contained appreciable amounts of total phenolic contents, total flavonoid, and percent inhibition of linoleic acid. Generally higher extract yields, phenolic contents, and plant material antioxidant activity were obtained using aqueous organic solvents, as compared to the respective absolute organic solvents. Although higher extract yields were obtained by the refluxing extraction technique, in general higher amounts of total phenolic contents and better antioxidant activity were found in the extracts prepared using a shaker.^[15]

PHARMACOLOGY

Antibacterial activity

Aqueous and ethanolic extracts of *F. religiosa* leaves showed antibacterial effect against *Staphylococcus aureus*, *Salmonella paratyphi*, *Shigella dysenteriae*, *S. typhimurium*, *Pseudomonas aeruginosa*, *Bacillus subtilis*, *S. aureus*, *Escherichia coli*, *S. typhi*.^[16-18] In another study, chloroform extract of fruits showed antimicrobial effect against *Azobacter chroococcum*, *Bacillus cereus*, *B. megaterium*, *Streptococcus*

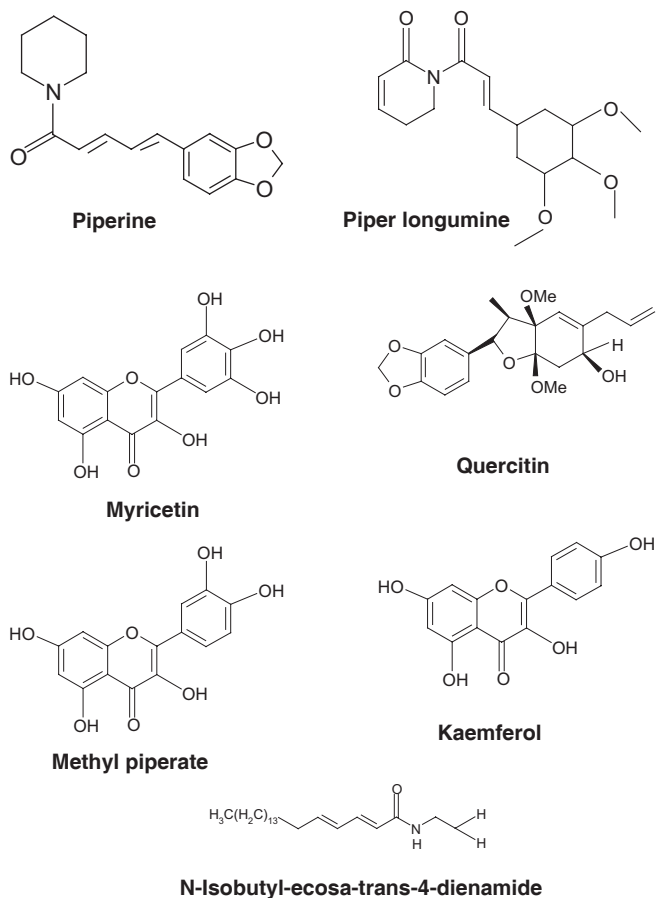


Figure 1: Phytoconstituents of *F. religiosa*

faecalis, *Streptomycin lactis*, and *Klebsiella pneumoniae*.^[17] The ethanolic extract of leaves showed antifungal effect against *Candida albicans*.^[18] Aqueous, methanol, and chloroform extracts from the leaves of *F. religiosa* were completely screened for antibacterial and antifungal activities. The chloroform extract of *F. religiosa* possessed a broad spectrum of antibacterial activity with a zone of inhibition of 10–21mm. The methanolic extracts possessed moderate antibacterial activity against a few bacterial strains. There was less antibacterial activity or none at all using aqueous extracts. The extracts of *F. religiosa* were found to be active against *Aspergillus niger* and *Penicillium notatum*. The extracts from the leaves exhibited considerable and variable inhibitory effects against most of the microorganisms tested.^[18, 19]

Anthelmintic activity

F. religiosa bark methanolic extract was 100% lethal for *Haemonchus contortus* worms.^[20] The stem and bark extracts of *F. religiosa* proved lethal to *Ascaridia galli in vitro*. The latex of some species of *Ficus* (Moraceae), i.e., *Ficus insipida*, *F. carica* was also reported to have anthelmintic activity against *Syphacia obvelata*, *Aspiculuris tetraptera*, and *Vampirolepis nana*.^[21] The pharmacological studies on *F. glabrata* latex with live *Ascaris* demonstrated a lethal effect at concentrations reduced to 0.05% latex in physiological saline solution. It has been accepted that anthelmintic activity is due to a proteolytic fraction called ficin. It is evident from above that methanolic extracts of *F. religiosa* possibly exerted anthelmintic effect because of ficin.^[22]

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.^[23]

Antioxidant activity

The literature showed that the antioxidative properties of the extract of *F. religiosa* fruit and bark were done using different solvents. They were evaluated on the basis of oil stability index together with their radical scavenging ability against 1, 1-diphenyl-2-picrylhydrazyl (DPPH).^[24] The oxidative stress and oxidative damage to tissues are common end points of chronic diseases such as diabetes, atherosclerosis, and rheumatoid arthritis. Oxidative stress in diabetes coexists with a reduction in the antioxidant status, which can further increase the deleterious effects of free radicals. The aqueous extract of *F. religiosa* reduces oxidative stress in experimentally induced type 2 diabetes rats. Type 2 diabetic rats gained relatively less weight during the course of development as compared to normal rats. Decrease in uptake of glucose, free fatty acids from circulation, and accelerated β -oxidation in adipose tissue lead to weight loss in diabetes. The aqueous extract of *F. religiosa* improved the body weight of diabetic rats.^[25]

Aqueous extract of *F. religiosa* modulated the superoxide dismutase (SOD) activity in the diabetic rats dose dependently and also decreased catalase (CAT) activity. It could be possible due to less availability of NADPH or gradual decrease in erythrocyte CAT concentration by excessive generation of O_2^{++} inactivates the enzyme. Since the activity of an enzyme depends upon its substrate, depletion of glutathione (GSH) may be the reason for decreased glutathione peroxidase (GSH-Px) activity. Aqueous extract of *F. religiosa* bark had upregulated the CAT and GSH-Px activities. Drug at higher dose (200 mg/kg) was better effective in modulating the enzyme.^[26]

The methanolic extract of *F. religiosa* leaf inhibits the production of nitric oxide and proinflammatory cytokines in lipopolysaccharide (LPS) stimulated microglia via the mitogen activation protein kinase (MAPK) pathway by using cell viability assay, nitric oxide assay, and enzyme-linked immunosorbent assay (ELISA). The extract exerts strong anti-inflammatory properties in microglial activation. It is likely that extract has a neuroprotective effect against inflammation by inflammatory mediators such as nitric oxide and cytokines.^[27]

Recently, the methanolic extract of *F. religiosa* has been reported to have neurotrophic effects and acetylcholinesterase inhibitory activity.^[28]

Wound-healing activity

The effect of hydroalcoholic extract of *F. religiosa* leaves on experimentally induced wounds in rats using different wound models results in dose-dependent wound-healing activity in excision wound, incision wound, and burn wound. A formulation of leaves extract was prepared in emulsifying ointment at a concentration of 5% and 10% and applied to the wounds. In excision wound and burn wound models, the extract showed significant decrease in the period of epithelization and in wound contraction (50%). A significant increase in the breaking strength was observed in an incision wound model when compared to the control. The result suggests that leaf extract of *F. religiosa* (both 5% and 10%) applied topically possess dose-dependent wound-healing activity.^[29]

Anticonvulsant activity

Methanolic extract of figs of *F. religiosa* had anticonvulsant activity against maximum electroshock (MES) and picrotoxin-induced convulsions, with no neurotoxic effect, in a dose-dependent manner. *F. religiosa* extract showed a significant protection in MES and picrotoxin-induced convulsion models in a dose-dependent manner. There was a significant decrease in the duration of tonic hind limb extension at all the three doses of extract (25, 50, and 100mg/kg) in MES model with maximum protection observed at 100mg/kg dose, as compared to control group. The anticonvulsant activity of the extract at 100mg/kg was found to be comparable to phenytoin-treated group; similarly, treatment with extract caused a dose-dependent delay of the latency to clonic convulsions in picrotoxin-induced convulsion model. However significant increase in the latency to clonic convulsions was observed only at 50 and 100mg/kg dose of extract as compared to control group. *F. religiosa* extract increased the threshold of MES and picrotoxin-induced convulsions with no neurotoxic effects, in a dose-dependent manner. Inhibition of antiepileptic effect of extract by cyproheptadine pretreatment showed that the extract might be mediating its effect via modulating serotonin-dependent GABAergic and/or glutamatergic neurotransmission.^[30]

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.^[31]

Hypoglycemic activity

β -Sitosterol-D-glycoside was isolated from the root bark of

F. glomerata and *F. religiosa*, which has a peroral hypoglycemic activity.^[32] 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.^[33]

CONCLUSION

Medicinal plants are the local heritage with the global importance. World is endowed with a rich wealth of medicinal plants. Medicinal plants also play an important role in the lives of rural people, particularly in remote parts of developing countries with few health facilities. The present review reveals that *F. religiosa* contains several phytoconstituents like β -sitosteroyl-D-glucoside, vitamin K, n-octacosanol, kaempferol, quercetin, and myricetin. The plant has been studied for their various pharmacological activities like antibacterial, antifungal, anticonvulsant, immunomodulatory, antioxidant, hypoglycemic, hypolipidemic, anthelmintics, and wound healing activities.

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