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A Review on Ficus Religiosa

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Abstract
Herbal medicine has been used for centuries and is considered one of the oldest and most valuable gifts to mankind. In India, herbs have always been the primary form of medicine. Medicinal plants contain complex chemical substances, known as secondary plant metabolites, which have curative properties. Among these plants, Ficus religiosa, also known as the sacred fig, Bodhi tree, Peepal in Sanskrit, is highly regarded in the field of medicine. It is a sacred tree worshipped by Hindus and is found all over India. Its different parts, including the bark, fruits, leaves, seeds, and latex, have been used in traditional medicine, such as ayurveda, siddha, Unani, and Homeopathy, to treat various ailments, including diabetes, diarrhoea, epilepsy, inflammatory disorders, gastric problems, sexual and infectious disorders. Recent studies have highlighted its diverse chemical structure and reported its efficacy in relieving multiple disorders. This paper provides an overview of its phytochemical and pharmacological properties.

Keywords: *Ficus religiosa*, Phytochemical, constituents, Pharmacology

Introduction

Medicinal plants have been used for centuries and contain bioactive compounds that are essential to traditional medicines [1]. As modern medicine seeks to develop more potent drugs with fewer side effects, medicinal plants remain a valuable source of new therapeutic agents [2]. These plants contain complex chemical substances, known as secondary plant metabolites, which contribute to their curative properties. Medicinal plants have been a consistent source of medicines for a wide variety of diseases throughout history [3]. Herbal medicine has a long history that dates back to the earliest human civilizations, and traditional medicines made from plants have gained global attention due to their potential pharmaceutical importance [4-5]. The beneficial effects of plant materials are often the result of the combination of secondary products present in the plant. In India, herbs have always been the primary form of medicine, as demonstrated by the use of Ayurveda, Siddha, Unani, and Homeopathy. Medicinal plants are part of the universal heritage and have significant importance. Natural product extracts derived from these plants are a crucial source of new drugs [6-8]. Ancient medical systems have utilized various parts of plants such as stem bark, root bark, aerial roots, vegetative buds, leaves, fruits, and latex to cure a wide range of ailments [9]. Medicines derived from herbs and plants have been extensively used in traditional cultures globally and are becoming increasingly popular in modern medicine as a source for developing new natural therapeutic compounds to treat aggressive diseases. Herbal medicines are preferred over synthetic remedies due to their natural origin. Medicinal plants offer a vast array of combinations of herbs and modern medicine [10-14].

Ficus religiosa

Ficus, a plant genus belonging to the family Moraceae, is a diverse group of trees, shrubs, and epiphytes with over 800 species found in tropical and sub-tropical regions worldwide. It is one of the most varied plant genera in terms of growth habit, featuring deciduous and evergreen free-standing trees, climbers, stranglers, creepers, small shrubs, lithophytes, and rheophytes [15]. The Ficus genus is composed of over 800 species, which are commonly known as figs or fig trees. These plants are widely distributed in tropical and sub-tropical regions of Asia, America, Australia, and Africa [16-18]. In India, certain species, such as Ficus benghalensis, are considered sacred and are referred to as the National Tree, symbolizing spiritual knowledge and eternal life [19]. Some species are edible, while others are used as ornamental plants, such as Ficus lyrata, also known as the fiddle-leaf fig. Ficus trees are known for their diversity in growth habits, ranging from free-standing trees to climbers and lithophytes. Additionally, they are some of the highest oxygen generators with a high rate of photosynthesis [20].

Ficus religiosa L. is a well-known member of the Ficus genus, with over 150 names. It is native to the sub-Himalayan region, Bengal, and central India, and has been widely cultivated worldwide [21]. The plant has been used in traditional medicine to treat various disorders and is mentioned in ancient scriptures of Ayurveda, Siddha, Unani, and Homeopathy. Ficus religiosa (L.) is a large perennial tree that is initially hairless and is found throughout the plains of India up to an altitude of 170m in the Himalayas. It is frequently planted along roads and near temples, where it is revered as a bodhi tree and holds great mythological, religious, and medicinal significance in Indian culture. The plant has been used in traditional Indian medicine to treat a wide range of ailments [23-26].

F. religiosa, a large perennial tree, is considered an herb and its bark, leaves, seeds, fruits, roots, and latex are all assessed for their therapeutic qualities. While the wood is not used for therapeutic purposes due to its highly porous nature, all other parts of the plant have medicinal properties that can be used in different forms and can also give best results when combined with other medicinal herbs. In traditional medicine, *F. religiosa* has been used for various ailments and has shown potential as an anti-cancer agent, wound healing agent, anti-bacterial, anti-convulsant, anti-viral, anti-protozoal, anti-diarrheal, astringent, anti-cholinergic, and as a treatment for gonorrhoea, amnesia, and diabetes. Studies have shown that F. religiosa induces apoptosis in breast cancer cell lines [27-32]. The bark of *F. religiosa* is also used in some Asian countries to treat various diseases, such as cervical cancer, epilepsy, inflammation, ulcers, infectious diseases, and as an acetyl cholinesterase inhibitor and anti-anxiety agent [33-35]. It is also used to treat skin diseases resulting from Kumkum (Bindi) application. *F. religiosa* is unique in that it releases oxygen continuously, unlike most plants that release oxygen during the day and uptake it at night. This is due to its ability to perform Crassulacean Acid Metabolism (CAM) photosynthesis, which allows it to uptake carbon dioxide during the night as well. *F. religiosa* is a hemiepiphyte, meaning its seeds germinate and grow as an epiphyte on other trees and then establish on the soil when the host tree dies. It is suggested that *F. religiosa* uses the CAM pathway to produce carbohydrates when it lives as an epiphyte and switches to C3 type photosynthesis when it lives on the soil [36-39].

TAXONOMY [40]

Scientific name	*Ficus religiosa* L

Common name	Peepal tree, bodhi tree, pippala tree
Domain	Eukaryote
Kingdom	Plantae
Subkingdom	Viridiplantae
Phylum	Tracheophyta
Subphylum	Euphyllophyte
Infraphylum	Radiatopses
Class	Magnoliopsida
Subclass	Dilleniidae
Suborder	Urticanae
Order	Urticales
Family	Moraceae
Genus	Ficus

Table 1: Taxonomical classification of *Ficus religiosa*

DISTRIBUTION:

Ficus religiosa is a species that is originally from the Asia-Tropical region, including countries such as Bangladesh, India, Nepal, Pakistan, China, Myanmar, Thailand, Vietnam, and Iraq [41]. The Tree is commonly found in forests and hilly areas in India, particularly near water streams, and is also grown in cultivation [42].

DESCRIPTION

Ficus religiosa, also known as the Peepal tree or Pimpala, is a commonly planted Ficus species in the tropics. It belongs to the Urostigma subgenus and has various traditional uses. This large tree can reach up to 30 meters (98ft) in height and 30 meters (9.8ft) in trunk diameter. Its leaves are chordate in shape with a unique extended drip tip, measuring 10-17 cm in length and 8-12 cm in width, with a 6-10 cm petiole [43]. The tree produces small figs that are 1-1.5 cm in diameter and green when unripe, maturing to purple. The leaves of the tree are known to move continuously even in still air, due to their long stalk and broad structure. Ficus religiosa has a bitter-sweet and acrid taste, and is used as an astringent, refrigerant, purgative, aphrodisiac, and laxative [44].

Fig: Ficus religiosa (Peepal tree)

ETHNOPHARMACOLOGY

Plant parts	Uses	References
Bark	Astringent, cooling, aphrodisiac, antibacterial, diarrhoea, Anti-inflammatory, antibacterial, antiprotozoal, antiviral, and in the treatment of gonorrhea, ulcers	[45]
Bark Decoction	Cooling, gonorrhea, skin, disease, Scabies, hiccup, vomiting	[46]
Leaves and tender shoots	Purgative, wounds, skin diseases, antivenom activity and regulates the menstrual cycle. tender branches are used as a toothbrush	[47]
Leaf juice	Asthma, cough, sexual disorders, Diarrhea, haematuria	[48]
Leaf decoction	Analgesic for toothache Dried fruit Tuberculosis, fever, paralysis Asthma, laxative, digestive	[49]
Fruit and fruit powder	Refrigerant, laxative, fruit powder is used to treat asthma.	[50]
Latex	Neuralgia, inflammations, haemorrhages [A3]	[51]
Seeds	Refrigerant, laxative	[52]

Table 2: Parts of plant used in diseases

PHYTOCHEMICAL CONSTITUENTS

Plants are known for their rich variety of phytochemicals that can serve as natural remedies for human health issues. F. religiosa has been studied for its phytochemical constituents, which include phytosterols, amino acids, furanocoumarins, phenolic components, hydrocarbons, aliphatic alcohols, volatile

components, and other secondary metabolites. Phenolic components such as tannins and flavonoids, as well as amino acids, are found in almost all parts of the plant [53].

Plant Parts	Compound Class	Compound Identified	Reference
Leaf	**Phenolics**	Eugenol, tannic acid	[54]
	Terpenoids \Terpenes	Lupeol, phytol, linalool, α-cadinol, α-eudesmol, β-eudesmol, epi-α-cadinol, γ-eudesmol, epi-γ-eudesmol, α-amyrin	
	Miscellaneous	Campestrol, isofucosterol, n-hexadecanoic acid, 12,15-octadecatrienoic acid, octadecanoic acid, butyl-9,12,15-octadecatrienoatet, stigmasterol, n-hexanol, adipoin 3-methylcyclopenetane-1,2-dione, phenylacetaldehyde, n-nonanal, palmitic acid, pentadecanal, n-nonacosane, n-hentricontanen, hexa-cosanol, n-octacosan	
Barks	**Phenolics**	Tannin, ceryl behenate, lupeol acetate, α-amyrin acetate, leucopelargonidin-3-O-β-D-glucopyranoside, leucopelargonidin-3-O-α-L-rhamnopyranoside	[55]
	Terpenoids \Terpenes	Lanosterol, lupen-3-one	
	Miscellaneous	β-sitosterol, stigmasterol, β-sitosterol-d-glucoside, leucoanthocyanidin, leucoanthocyanin, bergapten, bergaptol	
Stem	**Phenolics**	2,6-Dimethoxyphenol	[56]
	Miscellaneous	n-hexadecanoic acid, octadecanoic acid, stigmasterol, lanosta-8,24-dien-3-ol, acetate(3 beta), ergost-5-en-3-ol(3beta), 4H-Pyran-4-one,2,3-dihydro-3,5-dihydroxy-6-methyl, 2,4-bis(1,1-dimethylethyl)	
Roots	**Phenolics**	Ceryl behenate, lupeol acetate, α-amyrin acetate, leucocyanidin-3-0-β-D-glucopyrancoside, leucopelargonidin-3-0-β-D-glucopyranoside	[57]
	Terpenoids\ Terpenes	Lupeol	
	Miscellaneous	Saponin, β-sitosterol, leucoanthocyanidin, leucoanthocyanin	
fruit	**Terpenoids\ Terpenes**	β-caryophyllene, α-terpinene, dendrolasine, α-trans bergamotene, (e)-β-ocimene, α-pinene, limonene, dendrolasine, α-ylangene, α- thujene, α-copaene, β-bourbonene, aromadendrene, δ-cadinene, α-humulene, β-pinene, alloaromadendrene, germacrene, γ-cadinene, bicyclogermacrene	[58]
	Miscellaneous	Stigmasterol, lupeol, undecane, tridecane, tetradecane	

Seeds		Phytosteroline, β-sitosterol and its glycoside, albuminoids, carbohydrates, fatty matter, colouring matter, caoutchoue 0.7-1.5%	[59]

Table 3: Phytochemical constituents

Pharmacological Activity of *Ficus religiosa*

Ficus plants have indeed been extensively studied for their potential pharmacological effects. Different parts of the plant, such as leaves, stems, fruits, and roots, have been investigated for their bioactive compounds and their effects on various health conditions. Here are some of the reported pharmacological activities of Ficus plants [60].

Bioactivity	Plant parts	Solvent	Mechanism	Dosage	Ref
Antioxidant	Stem bark	Crude methanol, n-hexane, dichloromethane, ethyl acetate fractions	DPPH scavenging	>90% inhibition	[61]
	Bark	Ethanol (E) Methanol (M) Methanol	DPPH scavenging DPPH scavenging	E = 70.5% M = 69.0% IC50 = 48 µg/mL	[62]
	leaves	Methanol	H2O2 scavenging	IC50 = 49.85 µg/mL	[63]
Antidiabetic	Bark	Aqueous	**Model:** STZ-induced diabetic **Route:** Oral administration **Duration:** 21 days **Actions:** • reduced hyperglycaemia •Elevation in insulin levels and an increase in the uptake of glycogen by the liver and skeletal muscle. • Decrease in the levels of triglycerides and total cholesterol in the bloodstream.	250 mg/kg (BW)	[64]

		Methanol	Inhibition of the enzyme α-glucosidase.	IC50 = 83.72 µg/mL	[65]
Antimicrobial	Fruit stem	Ethanol Ethanol	• Strains of bacteria were tested and the zone of inhibition for K. pneumoniae was measured to be 21 millimetres. • Concentration of 15 mg/mL was used to test the bacterial strains and the zone of inhibition for S. epidermidis was found to be 19 millimeters. **Fungal strain:** Candida albicans: 10.6 mm	15 mg/mL 5 mL extract solution	[66] [67]
Anthelminthic	Latex	-	**Earthworm:** Pheretima posthuma **Duration:** 3 h **Action:** Earthworms experienced paralysis, which ultimately resulted in their death.	250 µL 500 µL	[68]
Hepatoprotective	Stem bark	Ethanol	**Model:** liver toxicity caused by CCl4 in albino rats and the liver damage induced by paracetamol in rats were studied. **Route:** Oral administration **Duration:** 36 h **Actions:** • decrease in the levels of aspartate aminotransferase (AST) and alanine aminotransferase (ALT) in the serum.	200 mg/kg (BW)	[69]

			• decrease in the extent of injury to the liver tissue. • reduction in the harmful effects caused by the metabolites of paracetamol and the CCL3 radical.		
Anticoagulant	Leaves	Methanol	• The normal range for Prothrombin time (PT) is between 17.7 and 26.7 seconds. • The normal range for Activated partial thromboplastin time (APTT) is between 47.7 and 72.3 seconds.	1 µg/µL	[70]
Fertility	Leaves (fresh and dry)	Aqueous	**Model:** Letrozole-induced PCOS **Route:** Oral administration **Duration:** 21 days **Actions:** • there was an upregulation of the PPAR-γ and Cyp19a1 pathways in the ovary. • The mechanism of insulin resistance was investigated/studied. • the process of synthesizing aromatase was studied as a means of stimulating androgen production. • the correction of steroid imbalances was observed to	1 mg/kg (BW)	[71]

			regulate the estrous cycle. • there was a decrease in the number of ovarian cysts observed.		
Anti-inflammatory	Latex	Methanol	**Model:** Cisplatin-induced liver injury **Route:** Oral administration **Duration:** 16 days **Actions:** • a decrease in the presence of hyaline droplets and tubular dilation was observed, and there was a recovery of the affected area. • the levels of serum urea and creatinine were restored to normal. • reduced lipid oxidation • normalized renal biomarkers (glutathione (GSH), superoxide dismutase (SOD), catalase (CAT), ATPase (Na+/K+ , Ca2+ , and Mg2+)	200 mg/kg (BW) 300 mg/kg (BW)	[72]
	Bark, Leaves, Aerial roots	Aqueous	• cell culture • The use of real-time polymerase chain reaction (PCR) led to the downregulation of matrix metalloproteinase1 (MMP) expression. • astringent activity	0.02, 0.05, 0.1, and 0.5 mg/mL	[73]

			• improved wound healing due to increased re-growth of epithelial cells.		
	Bark	Extract and ash-methanolic chloroform	**Model:** Burned wound Sprague Dawley **Route:** Topical application **Duration**: 15 days **Actions:** • complete wound closure • gradual regeneration of the epithelial layer. • development of granulation tissue • cellular proliferation	10% extract Formulation	[74]
	Leaves	Methanol	**Model:** Ethanol-induced gastric lesions **Route:** Oral administration **Duration:** 2 h **Actions:** • Decrease ulcer index through the action against the 5-lipoxygenase pathway • Enhance the PG synthesis, and also protects the gastric mucosa **Model:** Aspirin-induced gastric ulcer **Route:** Oral administration **Duration:** 10 days	250 mg/kg (BW) 500 mg/kg (BW)	[75]

			Actions: • The ulcer index was reduced by inhibiting the production of leukotrienes and acting on the 5-lipoxygenase pathway. • It promotes the synthesis of prostaglandins and provides protection to the gastric mucosa. **Model:** Pylorus ligated rats **Route:** Oral administration **Duration:** 7 days **Actions:** • Reduced ulcer index • It enhances the production of prostaglandins and safeguards the gastric mucosa.	250 mg/kg (BW) 500 mg/kg (BW) 250 mg/kg (BW) 500 mg/kg (BW	
Anti-cancer	Bark	Aqueous	The anti-cancer activity of cells was studied on cervical cancer cell lines, including SiHa-HPV16-positive and HeLa-HPV18-positive cell. **Actions:** • inhibited the proliferation of cancer cells. • The expression of p53, p21, and pRb proteins was increased.	E6 and E7 expression 0–80 µg/mL [74]	[76]

			• It reduces the expression of the phospho Rb (ppRb) protein. • It halts the progression of the cell cycle at the G1/S phase in SiHa cells. • It triggers apoptosis in HeLa cells by raising the intracellular Ca2+ concentration, which leads to the loss of mitochondrial membrane potential. • It stimulates the release of cytochrome, increases caspase-3 expression, and decreases the expression of MMP-2 and Her-G2 • It decreases the expression of viral oncoproteins.		
		Methanol	**Model:** Human breast adenocarcinoma **Actions:** • Complete cell destruction. • It induced both early and late apoptosis, resulting in 86.3% of apoptotic cells within the G0/G1 population. • At a concentration of 91 µg/mL, it increased the expression of BAX and caused the proteolytic cleavage	Bcl-2 genes 91 µg/mL	[77]

			of PARP-1, while also downregulating the expression of Bcl-2 genes.		
	leaves	Benzene (B) Acetone (A)	**Cell:** Breast cancer cells (MCF-7) MTT assay **Actions:** restrain cell proliferation and reduce cell viability.	(IC50) B = 160.3 µM A = 222.7 µM	[78]

Table 4: Pharmacological Activity of *Ficus religiosa*

CONCLUSION

The use of medicinal plants is an important part of traditional knowledge, and has a significant impact on the health of people in rural areas, particularly in developing countries where access to modern medicine may be limited. The Ficus species have been extensively studied for their pharmacological and phytochemical properties, and have shown potential as a source of bioactive compounds with a range of therapeutic applications. Further research is needed to identify and isolate the active components of these plants, which could be used as functional foods or pharmaceutical ingredients. Given their availability in nature and their pharmacological potential, Ficus species are an important resource for the development of new medicines and health products.

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