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Review on Morphological, Pharmacological and Ethnomedicinal Uses of Banyan Tree (*Ficus benghalensis* L.): A Sacred Medicinal Plant

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Abstract - *Banyan tree (Ficus benghalensis L.) of family Moraceae is commercially and traditionally important plant. It's useful in various ancient medicinal systems like Ayurveda, Unani and Siddha/Tamil. The plant is antidiabetic, hypolipidemic, anthelmintic, antibacterial, immunomodulatory, antistress, antiallergic, antioxidant, anti-inflammatory, antidiarrheal, analgesic, antipyretic, antiatherogenic, wound healing, and growth encouraging pharmacological properties. Ketones, flavonoids, flavonols, sterols, oentacyclic triterpenes and triterpenoids, furocoumarin, tiglic acid ester including some other esters, carbohydrates, serine protease as phytochemical components in the plant.*

Key Words: Morphology of banyan tree, Pharmacology of banyan tree, Ethno medicinal uses, sacred plant, *Ficus benghalensis* L

1. INTRODUCTION

The genus Ficus (Fig genus) is a member of family Moraceae, which has approximately 800 species. The most commercially important plants of this family are *Ficus benghalensis* (banyan tree), *Ficus religiosa* (Bo tree), *Ficus elastica* (rubber tree), *Ficus racemosa* (giant cluster tree), and *Ficus carica* (common fig). The vasculatures of all Ficus species contain latex-like substance, which provides protection and self-healing of the plant from physical attacks [1]. In the tropics, *F. benghalensis* is commonly grown plant [2]. The term "banyan" comes from the merchants who set their shop under the sprawling trees. On Front St. in Lahaina, one of Maui's most prominent banyan trees serves as a gathering spot for visitors, artists, children, and those selling their wares. In terms of spread, it is the world's biggest tree, with some older trees spanning over an acre of land. The trees feature as lovely red fruits and aerial roots that dangle from the branches [3]. *F. benghalensis* is known as the badh tree, Indian banyan tree, or East Indian fig tree. In the Ayurveda system, it is known as Vata, Nyagrodha, Bahupaada, and Dhruv in different medical systems. It is known as Bargad, Darakht-e-Reesh, and Aalamaram in Unani and Siddha/Tamil, respectively [4, 5].

1.1 Taxonomic Classification

Kingdom: Plantae

Division: Magnoliophata

Family: Moraceae

Genus: Ficus

Class: Magnoliopsida

Order: Urticales

Species: Benghalensis.

1.2 Origin, Habitat, and Distribution

It is native and originated in south Asia particularly India, Sri Lanka and Pakistan found in the sub-Himalayan region and peninsular India. It may be found from sea level to 1200 metres in India, and it originated in the sub-Himalayan area. It is found mostly in the deciduous woods of the Deccan and southern India. It is not an arid-region plant, although it is cultivated all throughout India. It may be found growing wild along roadsides and gardens. It is often occurred, planted around temples and place of religious interest. The plant is considered as sacred tree by both Hindus and Buddhists and worshiped on several occasions.

2. MORPHOLOGY OF PLANT

The banyan tree is a large tree with many branches that span a vast region. It may reach a height of 100 feet supported by prop roots, can cover several acres. The stem of plant has massive spreading branches with many aerial roots. The wood is greyish or greyish white in colour and reasonably durable. The smooth, thick bark is green in colour when young and greyish white when old, becoming pink when cut and peeling in sheaths. The wood is soft and porous with milky, sticky latex [6]. Leaves are simple, alternate, often in clusters at the ends of branches, stipulate, broadly elliptic to ovate, entire stalked, three-nerved, strongly 3 to 7 ribbed from the base, entire, petiolated; with a broad smooth greasy gland at the apex, compressed and downy. When fully developed, the leaves became glossy, leathery, and glabrous.

The male and female flowers are separated by the blossoms, which are quite little. The male flowers are crammed together towards the receptacle's opening. The female flower has a longer style and a shorter perianth. In the same receptacle, both the male and female may be found [7]. Flowers are axillary, sessile, in pairs, globose, brick red when ripe, and enclosing male, female, and gall flowers. Fruits are tiny, crustaceous achenes with fleshy receptacles around them [8]. A cherry's size is spherical and downy [9, 10]. Fruit is not suitable for human consumption, yet it is consumed by birds and primates [7]. The fruit contains a large number of tiny seeds. It has a tap root

system, but because to its prop roots, it may survive for a long period.

3. PHYTOCHEMICAL CONSTITUENTS

The plant has several phytochemical that make it beneficial for the biological community. Various primary and secondary metabolites are yielded from the plant like ketones, flavonoids, flavonols, sterols, oentacyclic triterpenes and triterpenoids, furocoumarin, tiglic acid ester and some other esters, carbohydrates, and serine protease.

(i) Ketones: Stem bark yielded three ketones as 20-tetratriacontene-2-one, 6-heptatriacontene-10-one, and pentatriacontan-5-one [11].

(ii)Flavonols and Flavonoids: There are two types of flavonoids. Quercetin-3-galactoside and rutin extracted from leaves [12]. The antioxidant properties of leaves are attributed to flavonols. The glycosides or flavonoids bengalenosides, 5, 7 dimethyl ether of Leucoperalgonidin-3-0-L-rhamnoside, 5, 3 dimethyl ether of leucocyanidin-3-O-D-galactosyl cellobioside, and 5, 7, 3 trimethoxy leucodelphinidin-3-O-L-rhamnoside are all found in stem bark [11]. Leucoperalgonidin, leucodelphinidin, and leucocyanidin are all flavonoids made up of various sugars connected to the OH groups.

(iii)Terpenoids: Friedelin, 3-friedelanol, beta-sitosterol, 20-traxasten-3-ol, lupeol, or betulinic acid, and -amyrin are pentacyclic triterpenes and triterpenoids found in banyan leaves [11].

(iv) Coumarins: It is isolated furocoumarins (coumarins) from banyan. Psoralen (also known as psoralene) is the parent component of the furocoumarin family of natural goods. It has a similar structure to coumarin, but the addition of a fused furan ring makes it a derivative of umbelliferone. Psoralen is a photosensitizing compound found naturally in tree seeds. Bergapten (5-methoxypsoralen) is another psoralen studied in banyan [13].

(v) Carbohydrates: *Ficus benghalensis agglutinin* (FBA) was named after a galactose-specific lectin discovered from the seeds of banyan fruits. FBA's carbohydrate-binding activity was independent of any divalent cation, like that of other Moraceae family lectins. FBA did not bind to simple saccharides. Sugar ligands containing aromatic aglycons, on the other hand, bind firmly [14].

(vi) Esters: The tiglic acid ester of ψ-traxasterol isolated from the heartwood of plant. Three novel esters, as well as linolyl glucoside and oleiyl glucoside, were recently extracted and characterised from a methanolic extract of the bark [15].

(vii) Serine Protease: By using an anion exchange chromatography method a serine protease was purify from banyan latex. The enzyme, known as benghalensin, plays a crucial function in biology [16]. Other constituents found in the bark include alpha-D glucose and meso-inositol [12].

4. PHARMACOLOGICAL PROPERTIES

The Rig-Veda is the earliest manuscript that discusses plant therapeutic qualities. The Charaka Samhita and Sushrusha Samhita, on the other hand, go into great depth on a variety of therapeutic herbs. In Indian System of Medicine (ISM) and other traditional medical systems across the globe, the banyan tree is an essential plant. The plant has enormous therapeutic and economic promise for humans. The following is a summary of the research-

4.1 Antiatherogenic Activity

A glycoside derived from the bark, leucopelargonin derivative (100 mg/kg/day), reduced fasting blood sugar and glycosylated haemoglobin by 34 and 28 percent, respectively, after a month of therapy in alloxan-diabetic dogs. Body weight was maintained in both the treatment and control groups; however it was reduced by 10% in the control group. The HMGCoA reductase and lipogenic enzyme activities in the liver, the lipoprotein lipase activity in the heart and adipose tissue, and the plasma Lecithin-Cholesterol Acyltransferase (LCAT) activity and the incorporation of labelled acetate into free and ester cholesterol all increased as the atherogenic index and hepatic bile acid level increased in rats fed a high-cholesterol diet [17].

4.2 Antidiabetic and Ameliorative Activity

The bark aqueous extract taken orally (500 mg/kg body weight/day) substantially reduced blood electrolyte levels in streptozotocin (STZ)-induced diabetic rats ($F > 0.05$; p 0.001). The pancreas of STZ-induced diabetic rats revealed considerable alterations in the shape of pancreatic cells, including moderate edoema and inflammation, according to histological investigation. After 12 weeks, blood electrolytes, glycolytic enzymes, and hepatic cytochrome P-450 dependent enzyme systems were restored, and the liver and kidneys ceased producing lipid peroxides.

Decoction of the bark has hypoglycemic properties [18]. This might be because bark contains a dimethoxy derivative of leucocyanidin 3-O-beta-D-galactosyl cellobioside. The ethanolic extract has anti-diabetic effect in male albino alloxan-induced diabetic rats in a research. The ethanolic extracts of banyan fruit, aerial root, and bark were given orally for 21 days and resulted in substantial reductions in blood glucose of 31.73, 18.33, and 28.84%, respectively. The ethanolic extract of the fruit had the greatest effects, decreasing blood sugar the most [19]. In oral administration, the antihyperglycemic action of amyrin acetate (-AA) isolated from the aerial roots was shown to be beneficial [20]. Phytosterolin, which was isolated from the roots and administered orally to fasting rabbits at a dosage of 25 mg/kg, had a maximal blood sugar-lowering effect after 4 hours that was 81 percent greater than the tolbutamide norm.

4.3 Hypolipidemic Activity

Aqueous bark extract has hypocholesterolaemic and hypolipidemic properties [21]. In rabbits with alloxan-induced diabetes mellitus, a water extract of bark was studied. The total blood cholesterol (TC) levels in sub-diabetic and diabetic rabbits were reduced from 8211 and 11810.6 mg per cent to 42.73.1 mg per cent and 51.74.7 mg per cent, respectively, after a month of treatment (50 mg/kg body weight/day). The levels of low density lipoprotein cholesterol and extremely low density lipoprotein cholesterol have also decreased [22].

4.4 Antihelmintic Activity

In Indian adult earthworms, methanolic, chloroform, and petroleum extracts of roots were shown to be anti-worm.

Anthelmintic action is due to the presence of carbohydrates, flavonoids, amino acids, steroids, saponins, and tannins as phytoconstituents in the extracts. The root extract have strong anthelmintic properties [23].

4.5 Antidiarrhoeal Activity

The ethanol extract of 4 distinct plants from the Khatra area of West Bengal's Bankura district was tested for antidiarrhoeal activity in rats using various diarrhoea models. When rats were fed PGE2, extracts of hanging roots of *F. benghalensis* prevented them from experiencing diarrhoea from castor oil and from pooling. The extract also exhibited a significant reduction in intestinal motility in rats fed charcoal meals [24].

4.6 Anti-inflammatory Activity

The milky liquid (latex) of the stem bark of tree is used by Ayurvedic practitioners in India to treat rheumatism and other inflammatory illnesses [25, 26]. MEFB's anti-inflammatory properties stem from its various impacts on inflammatory mediators, lysosomal enzymes, oxidative stress, and vascular permeability. Myeloperoxidase (MPO) is an enzyme found in small amounts in neutrophils, monocytes, and macrophages. The degree of MPO activity in inflamed tissue is related to the number of neutrophils present. In edematous tissues, MEFB reduces MPO activity. MEFB inhibits the production of malondialdehyde (MDA), a lipid peroxidation marker. This demonstrates that MEFB's anti-oxidant action contributes significantly to its anti-inflammatory effect [27].

4.7 Antibacterial and toxicological activity

The plant has a lot of antimicrobial properties [28]. The ethanolic extract of tree against *Pseudomonas aeruginosa, Proteus mirabilis, Stapylococcus aureus, Bacillus cereus, Alcaligenes faecalis,* and *Salmonella typhimorium* was studied. It was discovered to be antibacterial against *A. faecalis* and *S. typhimorium*, but not *S. aureus* [29]. The bark of tree has antibacterial action against gram-positive bacteria, *Actinomyces viscosus*, at concentrations of 0.08 mg/ml to 0.1 mg/ml. It may be found on a large percentage of smooth tooth surfaces and gingiva [30]. It's safe to eat since its non-toxic. Latex inhibits the development of *Penicillium citrinium* and, to variable degrees, reduces the formation of citrinin. *Epidermophyton floccosum* and *Microsporum gypseum* are completely poisonous to plant extract.

4.8 Immunomodulatory Activity

In vitro experiments revealed a considerable rise in the proportion of human neutrophils phagocytosing the aqueous extract of aerial roots. It showed promise as an immunostimulant in sheep red blood cells at dosages of 50, 100, 200, and 400 mg/kg body weight (SRBC). In rats, it also produced hypersensitivity and hemagglutination responses [31]. Milk-induced leukocytosis (antistress effect) and milk-induced eosinophilia (ant allergic impact) were used to test several extracts of banyan for their antiallergic and antistress potential in asthma [32]. Leukocytes and eosinophils were significantly reduced in aqueous, ethanolic, and ethyl acetate extracts, although petroleum ether and chloroform extracts were inert. Hence the polar components of bark have anti-stress and anti-allergic medicines in asthma.

4.9 Antioxidant Activity

Antioxidants protect the organism from oxidative stress by neutralising free radicals and reactive oxygen species (ROS) such as superoxide, hydroxyl, and hydrogen peroxide radicals, among others. Natural antioxidants such as flavonoids, flavonols, and terpenoids are popular alternatives [33]. The presence of phenolic and flavonoids in the aqueous extract of fresh aerial roots exhibited antioxidant action. Flavonoids contain the most diphenyl propane structure of all the phenolic, with varying degrees of oxidation, hydroxylation, and substitution. They're found as glycosides in plants and are a good source of antioxidants. Flavonoids and tannins were found in a phytochemical test, which might be responsible for the antioxidant action [34].

4.10 Analgesic and Antipyretic Activity

Ethanolic extract reduced raised body temperature significantly and worked as an analgesic and antipyretic agent, comparable to the non-steroidal analgesic medication aspirin. The presence of flavonoids, alkaloids, triterpenoids, and tannins may be responsible for the action, according to the phytochemical study [11].

4.11 Activity for Wound Healing

Vranaropaka is a word used in Ayurveda to designate a group of medications with wound-healing characteristics that come from plants, minerals, and animals. In wound healing experiments, *F. benghalensis, Cynodon dactylon, Symplocos racemosa, Rubia cordifolia, Pterocarpus santalinus, Ficus racemosa, Glycyrrhiza glabra, Berberis aristata, Curcuma longa, Centella asiatica, Euphorbia nerifolia,* and *Aloe vera* were shown to be effective [35].

4.12 Growth Promoting Activity

To heal wounds, *F. benghalensis* leaf powder is combined with coconut oil and administered topically to the afflicted areas. It has been shown to be effective 3 days, once a day [36]. Coagulation, inflammation, granulation tissue formation, matrix formation, connective tissue remodelling, collagenisation, and wound strength aquification are all steps in the wound healing process [37]. Alcohol and aqueous extracts of young prop roots were tested for their ability to promote growth. Its ability to promote growth in one-month-old immature female rats was tested. Alcohol and aqueous extracts of young prop roots are widely used to increase height among the tribes of Maharashtra state, India.

Animals given alcohol extract had statistically significant differences in characteristics including mean food intake, total body length, and alkaline phosphatase levels, a biochemical marker for bone production (p 0.05). Other metrics like as feed efficiency, tail length, relative organ weight, bone density, tibial epiphyseal cartilage breadth, and bone hydroxy proline levels did not show significant effects [38].

4.13 Bioactivity

In the potato disc bioassay, the fruit extracts were evaluated for bioactivity for anticancer activity. The absorption of calcium into rat pituitary cells GH_4C1 was not significantly inhibited by any of the extracts examined. The findings of this study back up

the usage of these herbs in folk medicine for respiratory problems and some skin ailments [39].

5. ETHANOMEDICINAL USES

In the religious ceremonies of the Indian system, it is revered. Ayurvedic medicine from India recommends the aerial root for lipid issues. The blood urea and serum cholesterol levels were decreased, and the root and stem bark demonstrated anti-diabetic characteristics. Diabetes, diarrhoea, seminal weakness, leucorrhea, menorrhagia, neurological problems, erysipelas, and burning sensation are all treated with an infusion of bark. The astringent and tonic bark is used to cure diabetes and leucorrhoea, lumbago, sores, ulcers, pains, and bruises. According to Ayurveda, it is astringent to the intestines and may treat biliousness, ulcers, erysipelas, vomiting, vaginal issues, fever, inflammations, and leprosy. The plant is used in a number of ayurvedic preparations, including Nyagrodhaadi Churnam (Bhaishajya Rutnavali), Saarivaadya Chandanaasava, Dineshavalyaadi Taila (Sahasrayoga), and samgrahaniya, Kasayacharna, Udumbarasa, Udunbaravaleha, and Udumbramatra [12, 40]. According to the Unani medical system, its latex is aphrodisiac, tonic, vulnerary, maturate, and reduces inflammations; it is helpful for piles, nasal problems, gonorrhoea, and other disorders.

The styptic aerial root may be used to cure a variety of ailments, including syphilis, biliousness, diarrhoea, liver inflammation, and others [41]. Milky juice is used to alleviate bruises, pain, and rheumatism. To treat spermatorrhea, two drops of fresh latex in a lump of sugar are administered once daily in the morning on an empty stomach. Naturally seeds are calming and energising [42]. Astringent qualities are present in leaf buds. A heated leaf poultice is used to treat abscesses, while a leaf infusion is used to cure diarrhoea and dysentery. The bark's astringent and tonic properties allow it to be used as a treatment for diabetes, leucorrhoea, lumbago, sores, ulcers, pains, and bruises. Applying milky juice and seeds externally is used to cure sores, ulcers, cracked foot soles, and rheumatic inflammations. Milky juice is used to alleviate bruises, pain, and rheumatism.

The treatment for haemorrhages is a milk and bud decoction. The styptic aerial root may be used to cure a variety of ailments, including syphilis, biliousness, diarrhoea, liver inflammation, and others [41]. As an antiemetic, aerial roots are used topically to acne.

Fruit extracts are used as folk medicine in the conventional system to treat several skin problems and respiratory ailments [39]. A paste of leaves is applied topically to abscesses and wounds to promote suppuration. According to legend, the tribes of India's Maharashtra state used young prop root (alcohol and aqueous extracts) to grow taller. In the tribal regions of Bengal's Midnapur (West) District, the banyan tree is one of the plants that is most often used to treat diabetes. For hypoglycaemic activity, make a decoction of bark and consume 40–80 mL of it twice day [18].

6. ECONOMIC AND SOCIAL APPLICATIONS

The fruit and the sheltered environment that the branches offer are beneficial to bats, monkeys and a variety of birds. The twigs and leaves are an excellent source of nutrients. The bark, leaves, latex, and root fibres are all valuable for their potential as medicines. It is venerated as the banyan tree's spouse in Hindu rituals [4, 5, 12]. The shade made it a need as a meeting place. In Hindu mythology, banyans-also referred to as the wish-fulfilling tree-appear to stand for eternal life. Hindus and Buddhists in India regard the tree as holy, and it is often planted close to temples.

7. CONCLUSIONS

Banyan tree is an important sacred medicinal of globe including Rajasthan. It exhibits many phytochemicals that are used in medications. It is used by traditional and ethnic groups to cure many diseases. The fruit and branches are sheltered for variety of birds and animals. The plant parts are an excellent source of nutrients, fibres metabolites.

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