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A Phyto – Pharmacological Overview on *Ficus Benghalensis* Linn

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ABSTRACT

Ficus benghalensis is commonly known as banyan tree, is a large semi deciduous tree reaching a height of 21 meter or more, found throughout India, either wild or cultivated. It is popular in Indigenous System of Medicine like Ayurveda, Siddha, Unani and Homoeopathy. In the Traditional System of Medicine, various plant parts such as bark, root, leaves, fruits and latex are used as antidiabetic, ophthalmic, refrigerant, antiemetic, anti-inflammatory, antidiarrhoeal, astringent and tonic. The present review is therefore, an effort to give a detailed survey of the literature on its traditional, pharmacognosy, phytochemistry and pharmacological uses.

Keywords: *Ficus benghalensis, Banyan tree, Pharmacognosy, Phytochemistry, Pharmacology, Traditional medicine.*

INTRODUCTION

Traditional and folklore medicines play an important role in healthcare services around the globe. About three quarters of the world's population relies on plants and plant extracts for health care. India has an ancient heritage of traditional medicine. The materia medica of India provides a great deal of information on the folklore practices and traditional aspects of therapeutically important natural products. Indian traditional medicine is based on various systems including Ayurveda, Siddha, Unani and Homoeopathy. The evaluation of these drugs is primarily based on pharmacological, phytochemical and allied approaches including various instrumental techniques such as microscopy, chromatography, spectroscopy and others. With emerging worldwide interest in adopting and studying traditional systems and exploiting their potential based on different healthcare systems, the evaluation of rich heritage of traditional medicine is essential.

Such plant is *Ficus benghalensis* Linn. Syn.- *Ficus Indica* Linn, family-Moraceae. The plant is a large deciduous tree found throughout the forest tract of India, in sub-Himalayan region, Rohilkhand, common in sal forest of Dehra Dun and Saharanpur, wild or cultivated all through Bihar, Orissa, West-Bengal, in deciduous forests of Deccan and in all districts from sea level to 1200m in deciduous and semi evergreen forests of south India.[1] It is found throughout the year and grows in evergreen forests, moist localities and bank of streams often cultivated in gardens, roadsides and villages for shade and its edible fruits [1, 2]. It is commonly known as Banyan tree in English, Bargad in Hindi, Vata in Sanskrit, Vada in Marathi, Peddamarri in Telgu and Ala in Kannada [3, 4]. Like *Ficus religiosa* (Pipal), *F.benjamina* (Sami), *F. racemosa* (Gular), *Ficus benghalensis* (Bar) have a high religious value for both Hindus and Buddhists and are deemed sacred.

A very large tree bearing many aerial roots, bark greenish white, leaves broadly ovate, obtuse, the base cordate; lamina 10-30cm long, 7-15cm wide, very coriaceous, puberulous beneath; lateral veins 5-7 pairs, the basel pair prominent, reaching 1/3 of lamina length; petiole 1.5-7cm long and wide, the fruit receptacles are axillary, sessile, in pair, globose, orange to red when ripe, male flowers pedicellate; tepals 2 or 3, female flowers sessile; tepals 3 or 4, gall flowers pedicellate; tepals 3 or 4 [4-6]. The tree with aerial roots. It naturally comes up in wasteland and forests in subtropical climate. It is seen dwelling in areas up to 1200m altitude on hilltop.

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This requires well-drained medium to heavy soil except in water logged and clay soil [7]. The plant is propagated by using cuttings of stem and root suckers. Hardwood cutting 0.5 to 1.5cm in diameter and about 30cm long are taken from straight, healthy 1-2 year old shoots and planted in December to February. Seeds can also used for propagation. Natural regeneration is very good from seeds dispersed by animals and birds. Four months old seedlings are transplanted to polythene bags and then planted in field after one month [7].

Traditional uses:

In the traditional system of medicine, the plant is used for various health problems and disease [2, 8]. Traditionally all the parts of plant are astringent, acrid, sweet, refrigerant, anodyne, anti-inflammatory, ophthalmic, styptic, anti-diabetic, antidiarrhoeal, antiarthritic, antiemetic and tonic. The aerial roots are useful in obstinate vomiting, osteomalacia of limbs, gonorrhea, dysentery and inflammation of liver. The bark is useful in burning sensation, haemoptysis, dysentery, diabetes, ulcers and hyperdipsia. An infusion of bark has specific properties in reducing blood sugar in diabetes and is a powerful tonic. A decoction of bark is used as an astringent lotion in leucorrhoea. Leaves are good for ulcer, leprosy, allergic conditions of skin. Leaves are heated and applied as a poultice to abscesses and wounds. The apical buds are useful in diarrhea and dysentery. The fruits and seeds are refrigerant and tonic. The milky juice (latex) is externally applied for pains and bruises and as an anodyne in rheumatism and lumbago. It is also used as a remedy for toothache and also consider as a valuable application to the soles of the feet when cracked or inflamed [2, 4, 9-11]. Some marketed formulations and preparations are *Nyagrodhadi churna, Nyagrodhadi ghrita, Sharivadyasava, karanjadya ghrita, Chandanadya taila, Ushirasava.*

Therefore the aim of this paper is to present an overview of pharmacognostical, traditional, phytochemical and pharmacological investigations carried out on the plant.

Pharmacognostical characteristics:

Macroscopical:

A large tree, juice milky. Bark grayish and smooth, 1.3cm thick, exfoliating in irregular flakes; wood grayish white, moderately hard with alternate rings of light and dark tissue, heartwood absent; leaves alternate, ovate, or elliptic, entire, obtuse, subcordate or rounded at base, thickly coriaceous, harsh, glabrescent above; nerve basal 3 to 7, lateral 4 to 6 pairs; petioles 2.5 to 5 cm stout; stipule, 1.9 to 2.5 cm, sheathing, deciduous, protecting leaf bud; male flowers crowded near mouth of receptacle perianth; 2 to 6-fid, imbricate, stamens 1 to 2, erect in bud; in female flowers, perianth is shorter, style excentric, and ovule pendulous. Fruit an enlarged hollow cup-shaped closed receptacle, the inner wall studded with crustaceous or fleshy achenes. Albumen scanty [4, 12].

Microscopical:

Transverse section of mature bark shows compressed cork tissue and dead elements of secondary cortex consisting of mostly stone cells and thin walled compressed elements of cortex. Cork cells are rectangular, thick walled and containing brownish content. Secondary cortex is wide, composed of large groups of stone cells and parenchymatous cells. Stone cells vary in shape. Parenchymatous cells somewhat cubical to oval, few in number and occur between groups of stone cells. Some of cells contain prismatic crystals of calcium oxalate, starch grains and tannin. Secondary phloem is composed of a few sieve elements, parenchyma, fibres, stone cells and latex tubes alternating with medullary rays. Phloem parenchymas are present in between patches of phloem fibres and stone cells [13].

In transverse section of leaf, epidermis is single layered with abundant uniseriate trichomes. Ground tissues are multilayered with thin walled, elongated, compactly arranged parenchymatous cells, and small, compactly arranged or loosely arranged rounded parenchymatous cells with chloroplast. Simple starch grains are clustered with crystals of calcium oxalate. Later, these cells develop into palisade and spongy parenchymatous tissue. In between the rounded parenchymatous cells, continuously arranged small rounded vascular bundles with poorly develop xylem and phloem is present. Stone cells are elongated and rectangular with broad and narrow lumen along with lignified walls. TS of the middle and basal region show almost similar structures except in the development of leaf structures with the differentiation of midrib and laminar region [14].

Powder:

Powder is light brown in colour, odour is agreeable and taste is slightly bitter with abundant trichomes on outer surface. Microscopically it shows presence of abundant prismatic crystals of calcium oxalate, either free or in detached parenchymatous cells. Portions of broken unlignified fibres with narrow lumen are at times associated with sclereids and or with cells containing calcium oxalate crystals. Medullary ray cells have a wavy outline and contain minute starch grains which are spherical or ovoid, simple. Occasionally parenchymatous cells with brownish contents are seen [14, 15].

Physical constants:

Foreign matter – Not more than 2 %; Total ash – Not more than 8 %; Acid insoluble ash – Not more than 3 %; Alcohol soluble extractive – Not less than 6 %; Water soluble extractive –Not less than 8 % [16].

Phytochemical properties:

Very little phytochemical work has been carried out on this plant *F. benghalensis*. Two flavonoid compounds, viz. 5,7dimethylether of leucopelargonidin 3-0-alpha-L-rhamnoside and 5,3-dimethyl ether of leucocyanidin 3-0-alpha-D galactosyl cellobioside were obtained from the bark of *Ficus benghalensis* [17]. From the bark Earlier glucoside, 20-tetratriaconthene-2-one, 6-heptatriacontene-10-one, pentatriacontan-5-one, beta sitostirol-alpha-D-glucose and meso-inositol has been isolated [18]. Three new esters as n-cos-16'-onyl octadecanoate (keto-n-cosanyl stearate), 19'-hydroxy-n-pentacosanyl hexadecanoate (hydroxypentacosanyl palmitate), and p-hydroxybenzyl tetradecanyl octadec-9-enoate (phenyl tetradecanyl oleiate) were isolated from the bark [19]. Leaves contain 9.63% crude protein, 26.84 % crude fibers, 2.53% CaO and 0.4% phosphorous. Latex containing Caoytchoue(2.4), Resin, Albumin, Cerin, Sugar and Malic acid [15]. The various solvent extracts of *Ficus benghalensis* show the positive test for the presence of Carbohydrates, Flavonoids, Proteins/Amino acids, Steroids, Saponins, Tannins, Glycosides and Alkaloids [20, 21].

Pharmacological Evaluation:

Hypoglycemic:

The aqueous extract of bark at a dose of 500mg/kg/day exhibits significantly antidiabetic and ameliorative activity in streptozotocin induced diabetic rats [22]. Hot water extract of bark was given orally to normal rabbits and rabbits with alloxan induced, alloxan recovered, mildly diabetic and severely diabetic states, at a single dose of 50 mg/kg/day for three days. After a gap of five days, the water extract was readministered for three days at a same dose level. There was no significant changes in fasting blood glucose (FBG), or glucose tolerance test (GTT) in normal rabbits. There was no fall in FBG but improvement in glucose tolerance in alloxan recovered rabbits. In mildly diabetic rabbits there was 55.8% fall in FBG values and improvement in glucose tolerance. The extract produce 68% fall in FBG values in severely diabetic rabbits [23]. In another study the glucose lowering effect of aqueous extract of aerial roots was studied at the dose of 300mg/kg both in normal and STZ induced diabetic rats, the dose showed a marked reduction in blood glucose level in sub- and in mild-diabetic rats [24].

The ethanol extracts of the fruits, aerial root and bark was studied for antidiabetic activity in alloxan induced diabetic rats, in this study the ethanol extract of fruits at a dosage of 120mg/kg body weight was found to exert a more pronounced antidiabetic activity than the ethanolic extract of the root or bark [25].

Fig. 1: *Ficus benghalensis* Linn

Antiatherogenic:

In cholesterol diet fed rats, as the atherogenic index and the hepatic bile acid level and the faecal excretion of bile acids and neutral sterols increased. The HMG Co A reductase and lipogenic enzyme activities in liver and lipoprotein lipase activity in heart and adipose tissue and plasma LCAT activity and the incorporation of labelled acetate in to free and ester cholesterol in liver decreased significantly [26].

Immunomodulatory effect:

The methanol extract of aerial root was evaluated for immunomodulatory activity in *in vivo* studies, using rats as animal model. The successive methanol and water extracts exhibited a significant increase in the percentage phagocytosis versus the control. In the *in vivo* studies, the successive methanol extract was found to exhibit a dose related increase in the hypersensitivity reaction to the SRBC antigen, at concentration of 100 and 200 mg/kg. It also resulted in a significant increase in the antibody titer value to SRBC, at the dose of 100 and 200 mg/kg in animal studies [27].

Antioxidant:

The antioxidant effect of aqueous extract of bark has been evaluated in hypercholesterolaemic rabbits. At a dose of 50 mg/kg body weight per day treatment with water extract decreased the serum cholesterol level by 59%, triacylglycsrol by 54% and LDL + VLDL- cholesterol by 69%. In addition, treatment with this extract led to a decrease in lipid peroxidation. The water extract of the bark has significant antioxidant activity [28]. In another study two flavonoid compounds, viz. 5,7 dimethylether of leucopelargonidin 3-0-alpha-L-rhamnoside and 5,3-dimethyl ether of leucocyanidin 3-0-alpha-D galactosyl cellobioside were obtained from the bark of *Ficus benghalensis* were evaluated for their antioxidant action in hyperlipidaemic rats. The compounds showed significant antioxidant effects [29].

Woundhealing:

Leaf powder mixed with coconut oil and applied topically on affected places to treat wounds. Dosage once a day for three days [30].

Anti-inflammatory:

The aqueous extract of aerial roots were evaluated for anti-inflammatory activity by carrageenan induced rat paw edema method, at the dose of 100 and 200 mg/kg body weight [31]. In another study the anti-inflammatory activity of ethanolic and petroleum ether extracts of bark was evaluated at the dosage of 300 and 600 mg/kg/day of bodyweight in carrageenan induced hind

paw edema in rats. The ethanolic and petroleum ether extract of bark significantly reduced carrageenan induced paw edema in rats [15]. Further one more study is carried out for aqueous and methanolic extracts of stem bark for evaluation of anti-inflammatory activity. The result show methanolic extract at the dosage of 200 and 400 mg/kg possesses significant anti-inflammatory activity in both acute and sub chronic models of inflammation [32].

Analgesic:

The methanolic extract of stem bark was evaluated for its analgesic activity at the dosage of 200 and 400 mg/kg. Acetic acid induced writhing is highly sensitive and documented model of visceral pain for screening of analgesic drugs. Methanolic extract of stem bark reduced the acetic acid writhing movements in mice significantly [32].

Anthelmintic:

The methanolic, chloroform, petroleum ether and aqueous extracts of roots were used and studied for paralysis and death of earthworm. All the extracts were found to show a potent anthelmintic activity when compared to standard drug albendazole. The two extracts show good anthelmintic activity as compared to other extracts, chloroform extract at 20 mg/ml cause paralysis at 3.71 min and death at 4.91 min and petroleum ether extract at 20 mg/ml shows paralysis at 4.03 min and death after 6.18 min [33].

Antidiarrhoeal:

Ethanol extract of hanging roots were evaluated for antidiarrhoeal activity against different experimental models of diarrhea in rats. The extract show significant inhibitory activity against castor oil induced diarrhea and PGE2 induced enteropooling in rats at a dose of 400 mg/kg p.o [34].

Antibacterial:

Different extracts of branching roots were tested for antibacterial potential against *B. cereus*, *S. aureus, E .aerogenes. E. coli, K. pneumoniae*. Out of all extracts methanol extract was the effective extract against the tested microorganism [35]. In another study the aqueous extract of bark has significant antibacterial activity against pathogenic bacteria [36].

Larvicidal:

The leaves of *Jatropha curcas, Ricinos communis, Lantana camara, Musa sapientum, Syzygium cumini, Citrus limon* and *Ficus benghalensis* were extracted in hot water and tested against *Anopheles stephensi, Aedes aegypti* and *Culex quinquefasciatus* larvae for their toxic effect. The mortality rate after 24 hours showed that *A. stephensi* larvae were most susceptible to both the treatment used as compared to the larvae of *C. quinquefasciatus* and *A. aegypti*. Among the seven leaf extracts used , *Citrus limon* leaf extract showed hundred percent mosquito larvicidal activity [37].

Growth promoting effect:

The growth promoting potential of alcohol and aqueous extracts of young prop roots was studied. Its growth promoting effect was evaluated in one month old immature female rats. Extracts were administered to young rats for 30 days. Significant ($p<0.05$) increase in body weight was observed in alcohol and aqueous extract treated immature female rats. Animals treated with alcohol extract showed statistically significant difference ($p<0.05$) in parameters such as mean food consumption, total body length and increase in alkaline phosphatase levels, a biochemical marker for bone formation [38].

Clinical evaluation:

A clinical trial was taken over 15 patient of burn with a polyherbal ointment, of which *Ficus benghalensis* root bark was one of the ingredients. It proved to be highly efficacious in controlling *Candida albicans* infections and helped in quicker epithelialisation. The burns was completely healed in 8 to 26 days of treatment [13].

A composite herbal drug, of which *Ficus benghalensis* was one of the constituents, was administered to 15 patients of leucorrhoea for 2 weeks in dose of 100 mg bd. complete relief was observed in 62 % cases, 18 % cases responded moderately and rest 10 % failed to attend follow up studies [13].

Toxicity:

LD_{50} of water extract of bark was found to be 1 gm/kg in rats when given orally. For chronic toxicity studies 3 dosage of aqueous preparation was given to 3 groups of rats. First group received 5 times ED_{50} (50mg/kg), second group 10 times ED_{50} (100mg/kg) and third group 15 times ED_{50} (150mg/kg) for 3 months. Forth group which served as control was given water. After 3 months results of the study showed that partially purified preparation from *Ficus benghalensis* is not toxic by the above mentioned parameters [39].

CONCLUSION

There are over-400 different tribal and other ethnic groups in India which constitute about 7.5 % of India's population. Tribal, rural and primitive societies have discovered solution for treatment of disease to almost all their needs and problems from the natural resources around them [40]. Hence in recent years, ethnomedicinal studies received much attention as this brings to light the numerous little known and unknown medicinal virtue especially of plant origin which needs evaluation on modern scientific lines such as phytochemical analysis, pharmacological screening and clinical trials [41]. *Ficus benghalensis* possesses various pharmacological activities as discussed in present paper. However, it is imperative that more clinical and pharmacological studies should be conducted to investigate the unexploited potential of this plant.

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