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Review: Indian national tree (*Ficus bengalensis*)

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Abstract

Ficus bengalensis also known as Indian banyan tree. Different parts of the tree have been found to possess medicinal properties; leaves are good for ulcers, aerial roots are useful in gonorrhoea, seeds and fruits are cooling and tonic. The roots of *Ficus bengalensis* are given for obstinate vomiting and infusion of its bark is considered as a tonic and astringent and is also used in diarrhoea, dysentery and diabetes. The bark of the plant is used in Ayurvedic medicine for the treatment of diabetes.

Keywords: *Ficus bengalensis*, Diseases, Tree

Introduction

Health and disease are two important areas which have engaged attracted the attention of mankind since time immemorial. The primitive man did not know about the medicine. In ancient time, people primarily depended on plant, which they were able to procure most easily as therapeutic agents and remedies. India has a rich heritage of knowledge on plant based drugs both for use in curative and preventive medicine. First medicinal use of plants is found in Rig Veda, which is approximately 8000 years old. In Atharveda remarkable description of Indian medicinal plants have been given by ancient Indian scholars. An Upaveda, Ayurveda composed around 2500 BC, deals with medicine, healthcare and treatment of disease from indigenous drugs. From veda it is learnt that Indo-Aryans used the 'Soma' (A Plant product) as a medicinal agent, which exhibits an amazing stimulating effect¹.

India has a rich source of biodiversity (both flora and fauna) possessing tremendous medicinal properties. The biodiversity of *Ficus* species ecosystem have attracted scientific attention throughout the world. It is not an exception of that trend. The ecosystem of *Ficus* species in India one of the important ecosystem in the tropics and has tremendous economic and medicinal values. Most of the information currently available about the *Ficus bengalensis* (FB) reveals that they are rich source of medicinal value, which have multidimensional curative properties.

Taxonomical classification (Source : USDA Plants.htm)

Kingdom:	Plantae –Plants
Subkingdom:	Tracheobionta
Superdivision:	Spermatophyta
Division:	Magnoliophyta
Class:	Magnoliopsida
Subclass:	Hamamelididae
Order:	Urticales
Family:	Moraceae
Genus:	<i>Ficus</i>
Species:	<i>bengalensis</i> (L)

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Fig. Plant of *Ficus benghalensis*

Distribution:²⁻³

Ficus benghalensis is native to India where it grows from low altitudes to 2000 ft (610 m), especially in dry regions. It is native to a wide area of Asia from India through Myanmar (Burma), Thailand, Southeast Asia, Southern China and Malaysia.

Synonyms:⁴⁻⁵

Sanskrit	:	Vata
English	:	Banyan tree
Hindi	:	Vada
Bengali	:	Bot
Gujrati	:	Vad
Marathi	:	Vad
Telugu	:	Maricheta
Tamil	:	Vada
Malyalam	:	Perala
Canarese	:	Aladamara
Punjab	:	Bera

Description:⁶

Leaves broadly ovate, obtuse, the base cordate; lamina 10-30 cm long, 7-20 cm wide, very coriaceous, puberulous beneath; lateral veins 5-7 pairs, the basal pair prominent, reaching 1/3 of lamina length; petiole 1.5-7 cm long, 5mm wide, puberulous, stipules thick, 1-1.5 cm long and wide, puberulous. Figs paired sessile, puberulous, depressed-globular, 1.5-2 cm diam., maturing orange to red; ostiole broadly unbonate, enclosed by 3 flat apical bracts; basal bracts 3, foliaceous, obtuse, 3-7 mm long, 10-15 mm wide, puberulous. Male flowers pedicellate; tepals 2 or 3. Female flowers sessile; tepals 2 or 4. Gall flower pedicellate; tepals 3 or 4 inch.

Cultivation:^{3,7}

F. benghalensis is widely cultivated in the tropics. It is cultivated in India and has not had its associated wasp introduced and therefore has not yet spread from initial plantings. *F. benghalensis* is the world's largest tree in terms of its spread with some old trees covering over an acre of ground. The tree's name "banyan" refers to the merchants who set up shop under the spreading trees. One of the most popular banyan trees, *F. benghalensis*, on Maui, located on Front St. in Lahaina, is a meeting place for tourists, artists, children, and folks selling their goods. In addition to the large spreading growth form, trees also have attractive red fruits and aerial roots which hang from limbs.

Pests and diseases:⁷⁻⁸

The pests associated with *Ficus* species: mealybugs, scale insects, spider mites, root knot nematodes, and thrips occur under most environmental conditions, fungal and bacterial leaf spots, crown gall, twig dieback etc.

Traditional Uses: ^{4-5, 9-10}

Different parts of the tree have been found to possess medicinal properties; leaves are good for ulcers, aerial roots are useful in gonorrhoea, seeds and fruits are cooling and tonic. The roots of *Ficus bengalensis* are given for obstinate vomiting and infusion of its bark is considered as a tonic and astringent and is also used in diarrhoea, dysentery and diabetes. Ayurvedic practitioners in India are using the milky juice (latex) of stem bark of *Ficus bengalensis* for the treatment of rheumatism and other inflammatory diseases. The bark of the plant is used in Ayurvedic medicine for the treatment of diabetes.

Chemical Constituents: ¹¹⁻¹³

Stem bark contains a number of anthocyanidin derivatives (methyl ethers of leucodelphinidin-3-O-L-rhamnoside, leucopelargonidin-3-O-L-rhamnoside, leucocyanidin-3-O-D-galactosylcellobioside) and aliphatic long chain ketones (pentatriacontan-5-one, tetratriacont-20-en-2-one, heptatriacont-6-en-10-one), besides beta-sitosterol glucoside and meso-inositol. The leaves contain 9.63% crude protein, 26.84% crude fibres, 2.53% calcium oxalate and 0.4% phosphorus. The various qualitative chemical tests of ethanol extract and aqueous extract of leaves contain sterols, flavanoids, phenol, tannins, and saponins in large amount whereas aromatic acids, carbohydrates, triterpenoids, gums, mucilage, and volatile oils were totally absent in this plant. The flavonols of the leaves have been identified as quercetin-3-galactoside and rutin.

Activity Reported:

Anti-inflammatory Activity:

The anti-inflammatory effect of ethanolic and petroleum ether extracts of bark of FB were evaluated in experimental animals by oral administration of doses of 300 and 600 mg/kg/day of body weight. The extracts were studied for their anti-inflammatory activity in carrageenan-induced hind paw edema in rats and the paw volume was measured plethysmometrically at 3 h after injection. The ethanolic and petroleum ether extracts of FB, significantly reduced carrageenan-induced paw edema in rats.¹²

The anti-inflammatory and analgesic effect of aqueous extract of FB (AEFB) and methanolic extract FB (MEFB) was evaluated in animal models. Preliminary results indicated that MEFB treatment possesses significant anti-inflammatory potential as compared to AEFB. The anti-inflammatory activity of MEFB exhibited in both acute and sub-chronic models of inflammation was found to be significant.¹⁴

Anthelmintic Activity:

The methanolic, aqueous, chloroform, petroleum ether extracts of FB were studied for paralysis and death of earthworm. All the extracts were found not only to paralyze (Vermifuge) but also to kill the earthworms (Vermicidal). The aqueous and methanolic extract was found to be more effective to execute the earthworm.¹⁵

Antihistaminic Activity:

Anti-cataleptic fractions were isolated from aqueous extract of FB bark. Six fractions 1 to 6 were isolated using column chromatography, silica gel (60-120#) as stationary phase. The effect of these fractions on clonidine induced catalepsy in mice was studied and it was found that fraction 4 inhibited significantly clonidine induced catalepsy as compared to control group at 50 mg/kg i.p. dose. Phytochemical analysis showed the presence of phenol, flavonoids and terpenoid.¹⁶

Antidiarrhoeal Activity:

Ethanol extract of four different plants like *Eugenia jambolana* (bark), FB (Bark), *Ficus bengalensis* (bark) and *Leucas lavandulaefolia* (aerial part) were evaluated for antidiarrhoeal activity against different experimental models of diarrhoea in rats. The extract of four different plants showed significant inhibitory activity against castor oil induced diarrhoea in rats. These extracts also showed a significant reduction in gastrointestinal motility in charcoal meal tests in rats.¹⁷

Immunomodulatory Activity:

The immunomodulatory activity of the aerial roots of FB using in vitro polymorphonuclear leukocyte (human neutrophils) function test. The methanol extract was evaluated for immunomodulatory activity in vivo studies, using rats as the animal models. The extracts were tested for hypersensitivity and hemagglutination reactions, using sheep red blood cells (SRBC) as the antigen. 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 concentrations of 100 and 200

mg/kg. It also resulted in a significant increase in the antibody titer value, to SRBC at doses of 100 and 200 mg/kg in animal studies.¹⁸

Antimicrobial Activity:

The barks of *Ficus religiosa* and FB were investigated for invitro antibacterial activity and photochemical analysis. The various solvents extract like aqueous, methanol, petroleum ether and hexane were screened for anti bacterial activity against Enterotoxigenic *E.coli* isolated from diarrhoeal patients. The extracts were subjected for antibacterial activity against Enterotoxigenic *E.coli* at 200mg/kg concentration by disc diffusion method. The results of anti bacterial revealed that methanol extracts. Petroleum ether and hexane extracts did not show any activity. The anti bacterial activities of extracts compared with standard antibiotics.¹⁹ The antimicrobial activity of *Hemidmus indicus*, FB, and *Ptrocarpus marsupium marsupium roxb* was evaluated against pathogenic bacteria *Stabylococcus aureus*, *Pseudomonas aeruginosa* and *Klebsiella pneumonia* in an in vitro condition. Aqueous extracts from roots of *H. indicus* are barks of *f. bengalensis* and *P. marsupium roxb* were tested for antimicrobial activity using the zone of inhibition growth of bacteria with the minimal inhibitory concentration ranging from 0.04 mg to 0.08 mg and extracts of FB and *H.indicus* showed inhibition at the range of 0.04mg-0.1 mg against the bacteria tested.²⁰

Allelopathic Activity:

Well grown trees of FB produce one or more potential inhibitors of seed germination and seedling growth. The aqueous extract of ficus leaf and bark enhanced the shoot length and root length of *Vigina radiate* when plants were exposed to 5% and 6% concentration of aqueous leaf extract of FB. Bark extract of FB inhibited the shoot length and root length of the plant at high concentration. Both the bark and leaf extract inhibited the seed germination. The result suggests that FB may have potential allelochemicals which may be developed as natural herbicides.²¹

Antidiabetic Activity:

The ethanolic extracts of the different aerial parts of FB were comparatively evaluated for their blood glucose lowering activity. Histopathology of the treated groups was carried out to evaluate the betacytotropic activity of various part of FB. The ethanolic extracts of the fruit at a dose of 120 mg/kg body weight was found to exert a more pronounced antidiabetic activity than the ethanolic extract of the root or bark. The experiment also confirmed antidiabetic activity of the standard drugs glibenclamide.²² To evaluate the antidiabetic and ameliorative potential of aqueous extract of FB bark in streptozotocin induced diabetic in rats. The effect of oral administration of aqueous extract of FB bark on blood glucose, serum electrolytes, serum glycolytic enzymes, liver microsomal protein, and hepatic cytochrome P-450 depended monooxygenase enzymes and lipid peroxidation in liver and kidney of streptozotocin induced diabetic in rats was studied. Oral administration of FB to fed, fasted and glucose loaded diabetic rats significantly decreased the blood glucose level at 5 hrs and restored the levels of serum electrolytes, glycolytic enzymes, glycolytic enzyme and hepatic enzyme systems and decreased the formation of liver and kidney lipid peroxidation at the end of 12 weeks.²³ Hot water extract of FB was given orally to normal rabbits and rabbits with alloxan induced and 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 the same dose level. There was no significant change in fasting blood glucose, or glucose tolerance test in normal rabbits. There was no fall in fasting blood glucose but improvement in glucose tolerance in alloxan recovered rabbits. In mildly diabetic rabbits there was 55.8% fall in fasting blood glucose values and an improvement in glucose tolerance.²⁴ The water extract of the bark of FB which was demonstrated in this studies to have significant hypoglycemic and hypocholesterolemic effect on alloxan induced, mild and severe diabetes in rabbits. Result of the study showed that partially purified preparation from FB is not toxic by all the mentioned parameters.²⁵ The antidiabetic potential of *Ficus bengalensis* aerial roots as its bark had already been reported to possess antidiabetic efficacy.: Effect of variable doses of aqueous extract of *Ficus bengalensis* aerial roots on blood glucose level (BGL) of normal-, sub- and mild-diabetic models have been studied and the results were compared with the reference drug Glipizide and elemental Mg and Ca intake as glycemic elements.: The dose of 300mg kg⁻¹ showed the maximum fall of 43.8 and 40.7% in BGL during FBG and glucose tolerance test (GTT) studies of normal rats, respectively. The same dose showed a marked reduction in BGL of 54.3% in sub- and 51.7% in mild-diabetic rats during GTT. The concentration of Mg (1.02%) and Ca (0.85%) identified through laser induced breakdown spectroscopy (LIBS) in the most effective dose could be responsible for this high percentage fall in BGL as they take part in glucose metabolism. The hypoglycemic effect in normoglycemic and antidiabetic effect in sub- and mild-diabetic models of

aqueous extract of aerial roots of *Ficus benghalensis* are due to the presence of these glycemic elements in high concentration with respect to other elements.²⁶

Antioxidant Activity:

The stem bark and fruits of FB and *Ficus racemosa* are used in India for the treatment of diabetes a number of other diseases. Since these effect may be correlated with the presence of antioxidant compounds, methanol and 70% acetone (acetone: water, 70:30) extracts of FB (aerial root) and *F.racemosa* (stem bark) were evaluated for their antioxidant activity and radicals scavenging capacity in comparison with *camellia sinensis*. Methanol extracts of green tea and 70% acetone extract of *F.racemosa* contained relatively higher levels of total phenolics than the other extracts .The antioxidant potential of the extracts were assessed by employing different in vitro assays such as reducing power assay DPPH ,ABTS and OH redicalscavenging capacities, peroxidation inhibiting activity through linoleic acid emulsion system antihemolytic assay by hydrogen peroxide induced method and metal ion chelating ability.²⁷Total phenolics, flavonoids and flavonol contents of some medicinal plants were determined in the aqueous extracts of leaves of *Tichosenthes dioica*, fruit of *Moringa olifera* and FB as well as seeds of *Emblica officinalis*. Total antioxidant activity of these extracts was monitored by free radical absorbing power *assay*. In this work, those parts of the plants are used for the analysis of aforesaid parameters which are normally overlooked. The total phenolic content of *T. dioica* leaves was about two times more than that obtained from the fruits and seed of *M. olifera* and *E. officinalis*, respectively. However the aerial roots FB registered presence of least phenolic content. The aqueous preparation from *E.officinalis* exhibited total flavonoid content twice as high as that of the other three plants.²²

Antifungal Activity:

Mitosporic fungi and several sterile forms were isolated as endophytes from the leaf tissuesand aerial roots of *Ficus benghalensis* (Moraceae). Although similar number of endophyte species was present in lamina and petiole, the endophytic fungi more densely colonized the petiole. The species composition and the colonization frequency of the endophytes were more for the aerial roots entering the soil when compared with those growing in the air since the roots recruited some endophytes from the soil. The endophyte assemblages of the leaf and aerial root and of the aerial root growing in the air and soil showed little overlap suggesting that the nature of the host tissue as well as the environment determine the endophyte Composition of a host.²⁸

Antibacterial activity:

The antibacterial activity against 5 important bacterial strains, namely *Bacillus subtilis* ATCC6633, *Staphylococcus epidermidis* ATCC12228, *Pseudomonas pseudoalcaligenes* ATCC17440, *Proteus vulgaris* NCTC8313 and *Salmonella typhimurium* ATCC23564. The antibacterial activity of aqueous and methanol extracts was determined by agar disk diffusion and agar well diffusion method. The methanol extracts were more active than the aqueous extracts for all 12 plants studied. The plant extracts were more active against Gram-positive bacteria than against Gram-negative bacteria. The most susceptible bacteria were *B. subtilis*, followed by *S. epidermidis*, while the most resistant bacteria were *P. vulgaris*, followed by *S. typhimurium*.²⁹

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