REVIEW: EVALUATION OF ANTIOXIDANT, ANTIMICROBIAL AND ANTI-INFLAMMATORY ACTIVITIES OF *FICUS RACEMOSA* EXTRACT

Deepa N. Muske*

Manorama B. Motegaonkar**

Sarika S. Shinde***

Abstract

Ficus racemosa is a species of plant in the Moraceae family. Popularly known as the Cluster Fig Tree, Indian Fig Tree or Goolar Fig, this is native to Australia, Malesia, South-East Asia and the Indian Subcontinent.It is a popular medicinal plant in India, which has long been used in Ayurveda, the ancient system of Indian medicine, for various diseases/disorders including diabetes, liver disorders, diarrhea, inflammatory conditions, hemorrhoids, respiratory, and urinary diseases. F. racemosa is pharmacologically studied for various activities including antidiabetic, antipyretic, anti-inflammatory, antitussive, hepatoprotective, and antimicrobial activities. A wide range of phytochemical constituents have been identified and isolated from various parts of F. racemosa. In this review, a comprehensive account of its antioxidant, antibacterial and anti-inflammatory effects is presented in view of the many recent findings of importance on this plant. And how it can help agriculture for production of biological control of pest and disease.

Keywords: *Ficu sracemosa* Linn., Moraceae, antioxidant, antimicrobial, anti-inflammatory activities, Phytoconstituents

* PhD scholar, Biotechnology centre, Dr.Panjabrao Deshmukh Krishi Vidyapeeth, Akola,

** Azad College Ausa,

*** MSc. College of Agriculture, Latur MS, INDIA

INTRODUCTION

The genus *Ficus* constitutes an important group of trees with immense medicinal value. Among the variednumber of species, the most important ones are the four trees that constitute the group "*Nalpamaram*", namely, *F. racemosa, F. microcarpa, F.benghalensisand F. religiosa commonly found in the world.* Ficus is a huge tropical, deciduous, evergreen tree with more than 800 species. Bark, root, leaves, fruit and latex of this plant are frequently usedfor the treatment of various illnesses. Ficus produces a unique fruit which is actually a inverted flower. Ficus species are rich source of polyphenolic compounds, flavanoids which are responsible for strong antioxidant properties that help in prevention and therapy of various oxidative stress related diseases such as neurodegenerative and hepatic diseases. The barks, leaves, fruits and latex are considered to be very effective in various treatments, such as diabetes, skin diseases, ulcers, dysentry, diarrohoea, stomachache, piles and as carminative, astringent, anti inflammatory, antioxidant and anticancer agent.

Scientific Classification

Kingdom: Plantae

Division: Magnoliophyta

Class: Magnoliopsida

Order: Rosales

Family: Moraceae

Genus: *Ficus*

Species: *F. racemosa*

Synonyms: *Ficusglomerata* Roxb

***Ficus racemosa*Linn.**

Gular fig, Cluster fig or Country fig, which is considered sacred, has golden coloured exudates and black bark [1]. This is native to Australia, South-East Asia and the Indian subcontinent. It is unusual in this plant that its figs grow on or close to the tree trunk. It is one of the herbs mentioned in all ancient scriptures of Ayurveda. It has various synonyms like yajnanga, yajniya, yajnayoga, yajnyasara etc. suggesting its use in ritual sacrifice. The plant grows all over India in many forests and hills. It is frequently found around the water streams and is also cultivated [2]. Leaves are ovate, ovate-lanceolate or elliptic, subacute, entire and petiolate and

are shed by December and replenished by January and April,when the tree becomes bare for a short period. It is seen dwelling in areas up to 1200 m altitude on hilltop. This requires well-drained, medium to heavy soils for its successful cultivation and comes up in all kinds of soils except in water logged and clay soil.

The plant is propagated by using cuttings of stem and root suckers. Seeds can also be used for propagation. The flowers are pollinated by very small wasps. It has evergreen leaves, if it is close to a water source. Otherwise it sheds its leaves in January. Figs have been traditionally used bychildren to play. Thin sticks can be joined byinserting them in goolar figs to make interesting shapes [3].

Phytochemicals constituent of ficus racemosa

The leaf of this plant contains sterols, triterpenoids (Lanosterol) and alkaloids, tannins and flavonoids. Stem-bark gives gluanol acetate, β-sitosterol (1), leucocyanidin-3-O-β-D-glucopyrancoside, leucopelargonidin- 3-O-β-D-glucopyranoside, leucopelargonidin-3-O-α-L-rhamnopyranoside, lupeol (2),cerylbehenate, lupeol acetate (3) and α-amyrinacetate (4). From trunk bark, lupenol, β-sistosterolandstigmasterol (5) were isolated. Fruit contains gluanol acetate, glucose, tiglic acid (6), esters of taraxasterol, lupeol acetate, friedelin (7), higherhydrocarbons (Hentriacontane) and other phytosterols. A new tetracyclic triterpeneglauanolacetate which is characterized as 13α, 14β, 17βH, 20αH-lanosta-8, 22-diene-3β-acetate and racemosicacid (**8**) were isolated from the leaves. An unusual thermostable aspartic protease was isolated from latex of the plant. The stem bark and fruit showed presence of gluanol acetate [4,5,6]. Bark of *Ficus racemosa* contain chemicals liketwo new anthocyanin: leucocyanidin-3-0-β-glucopyranoside, leucopelarogonidin-3-0-α-Lrhamnopyranoside, β-sitosterol unidentifiedlong chain ketone, cerylbehenatelupeol, it'sacetate, α-amyrinacetatete.

The bark of *F. Racemosa* showed the presence of phyto-chemical constituents namely alkaloids, carbohydrates, flavonoids, glycosides, saponins, steroids, tannins, phe-nols, triterpenoid, fixed oils and fats and the absence of anthraquinones, and amino acids [7]. Benjaminamide: A new ceramide from the twigs of *F. benjamina*was identified [8]. The EtOAc of *F. barteri*fruits has led to the isolation and characterization of 3,5,4'-trihydroxystilbene (trans-resveratrol), 3,5,3',4'-tetrahydroxystilbene and catechin. The main antibacterial compound was 3,5,3',4'-tetrahy-droxystilbene with MIC values of 25 μg/ml for *S. aureus*, 50 μg/ml for *B. subtilis*and > 400 μg/ml for *E. coli* and *P. Aeruginosa* [9]. A triterpene, conrauidienol, and

dihydroflavonol, conrauiflavonol, along with *β*-amyrin acetate, betulinic acid, ursolic acid, 6*β*-hydroxystigmasta-4,22-dien-3-one, 8-prenylapigenin, *β*-sitosterolglucoside, and 3,4′,5-trihydroxy-6″,6″-dimethylpyrano-flavone were isolated from the stem barks of *F. conraui*and the Hex, EtOAc and MeOH extracts, as well as the new isolated compounds that exhibited selective antimicrobial activities varying from weak to moderate [10].

Antioxidant properties

The stem bark and fruits of *Ficus racemosa* L. is used in India for the treatment of diabetes and a number of other diseases. Since these effects may be correlated with the presence of antioxidant compounds, methanol and 70% acetone (acetone:water, 70:30) extracts of *F. bengalensis* (aerial root) and *F. racemosa* (stem bark) were evaluated for their antioxidant activity and radical scavenging capacity in comparison with *Camellia sinensis* (L.) O. Kuntz (green tea). Methanol extracts of green tea and*F. bengalensis* 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$^{\bullet}$, ABTS$^{\bullet+}$ and $^{\bullet}$OH radical scavenging capacities, peroxidation inhibiting activity through linoleic acid emulsion system, antihemolytic assay by hydrogen peroxide induced method and metal ion chelating ability.

Bark	MeOH, Isopropanol, CHCl3, Diethyl Ether, Hex	Well diffusion, micro broth dilution.	0.5-4 mg/ml	Antibacterial activity [11]	The extracts showed antibacterial activity against standard strains and clinical isolates.
Roots	Aq, EtOH	Disc-diffusion.	25-75 mg/ml	Antibacterial activity [12]	The EtOH extract having good antimicrobial activity towards *S. aureus.*
Bark	AC, MeOH, EtOAc	Disc diffusion.	25-100 µg/ml	Antibacterial activity [13]	moderate activity.
Leaves	EtOH	Well diffusion.	0.15- 75 mg/ml	Antibacterial activity [14]	moderate activity.

Though all the extracts exhibited dose dependent reducing power activity, methanol extracts of all the samples were found to have more hydrogen donating ability. Similar line of dose dependent activity has been maintained in all the samples in DPPH. and .OH scavenging systems. All the extracts exhibited antioxidant activity against the linoleic acid emulsion system (34–38%). The potential of multiple antioxidant activity was evident as it possessed antihemolytic activity and metal ion chelating potency. Ethanol extract (FRE) and water extract (FRW) of *Ficus*were subjected to free radical scavenging both by steady state and time resolved methods such as nanosecond pulse radiolysis and stopped-flow spectrophotometric analyses. FRE exhibited significantly higher steady state antioxidant activity than FRW [15].

Antimicrobial properties:

Antimicrobial methods [disc and well diffusion, minimum inhibitory concentration (MIC), minimum bacterial concentration (MBC)] were used to evaluate the different extracts of ficusracimosa**.** The plant possesses potent inhibitory activityagainst six species of fungi, viz. Trichophytonmentagrophytas, Trichophytonrubrum,Trichophytonsoundanense, Candida albicans,Candida krusei and Torulopsisglabrata [16,17]. [18] Reported that the stem bark extracts had an activity against *B. subtilis*. The maximum inhibition against *S. aureus*was observed from ethanolic extract solutions of the roots [12]. The MeOH, isopropanol, CHCl3, diethyl ether and Hex extracts were evaluated against the growth of multi-drug resistant of five strains of *S. aureus, K. pneumoniae, P. aeruginosa,* and *Enterococcus faecalis* [11]. The zone of inhibition of various extracts for dia-betic foot ulcer isolates is as follows: MeOH (21 mm) and Aq (19 mm) for *P. aeruginosa*; MeOH (21 mm) for *S. aureus*; MeOH (20 mm), Aq (20 mm) and isopropanol (19 mm) for *Enterococcus faecalis*; isopropanol (21 mm), MeOH (20 mm) and Aq (20 mm) for *K. pneumoniae*. The AC, MeOH, EtOAc of bark extracts showed moderate antibacterial activity against *P. aeruginosa*, *E. coli*, *P. vulgaris*, *B. subtilis*and *S. Aureus* [13].The lowest MIC value (156g/ml) observed with the crude extract was recorded on *Streptococcus faecalis*, *Candida albicans*and *Microsporumaudouinii*. The corresponding value for fractions (39 µg/ml) was noted with FOB4 against *Staphylococcus aureus*, while that of the tested compounds (10 µg/ml) was observed with compound 8 on *Microsporumaudouinii*.

Methanol extracts of bark, fruits and leaves of *F. microcarpa* exhibited excellent antioxidant activities and also possessed antibacterial activity against tested Gram-positive and Gram-negative bacteria. Ethyl acetate fraction of bark extract (BE) exerted strong antioxidant

and antibacterial effects and contained high amount of total phenolics (436 GAE mg/g extract). EC_{50} values of BE were 4.83, 1.62 and 63.2 µg/ml in DPPH, $ABTS^{\bullet+}$, superoxide radicals scavenging methods, respectively. Inhibition zones of BE against *Bacillus brevis*, *Bacillus cereus*, *Bacillussubtilis*, *Escherichia coli* and *Achromobacter polymorph* were 18.0, 15.5, 16.5, 16.0 and 8.0 mm, respectively.

Anti-inflammatory properties

Inflammation is the body's immediate response to damage to its tissue & cells by pathogens, noxious stimuli such as chemicals or physical injury [19]. It is a protective attempt by the organism to remove the injurious stimuli and initiate the healing process [20]. The various mediators involved in inflammation include cytokines &chemokines, PG's, platelet activating factor (PAF), NO and histamine etc. PG's are generally considered to be potent pro-inflammatory mediator [21]. Further, evidence suggests that during inflammation there is increased generation of ROS. It has been found that Mast cell degranulation also imparts a role in inflammation due to release of several mediators like Histamine, which are implicated in the inflammation and allergy [22]. The anti-inflammatory activity of *F. Racemosa* extract wasevaluated on carrageenin, serotonin, histamine anddextran-induced rat hind paw edema models. The extract (400 mg/kg) exhibited maximum anti-inflammatory effectof 30.4, 32.2, 33.9 and 32.0% with carrageenin, serotonin,histamine, dextran-induced rat paw oedema,respectively. In a chronic test, the extract (400 mg/kg) showed 41.5% reduction in granuloma weight, which wascomparable to that of phenylbutazone [23]. Bioassay-guided fractionation of the ethanol extract ofleaves isolated racemosic acid. It showed potentinhibitory activity against COX-1 and 5-LOX in vitro withIC50 values of 90 and 18 µM, respectively [24]. Ethanol extract of stem bark also inhibited COX-1 withIC50 value of 100 ng/ml proves that the drug is used inthe treatment of inflammatory conditions [25].

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 [26]. Hence, in recent years, ethno medicinal studies received much attention as this brings to light the numerous little known and unknown medicinal virtues especially of plant origin which needs evaluation on modern scientific lines such as phytochemical analysis,

pharmacological screening. *F. Racemosa* 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. The phytochemical constituent can be purified and used as an antioxidant, antimicrobial and anti-inflammatory purposes. And even the plant extract can be used to control the plant diseases in field which causes economic losses in the field and deteriorate the quality of food.

REFERENCES:

[1] Joy PP, Thomas J, Mathew S, Skaria BP. 2001. Medicinal Plants. Tropical Horticulture (Vol. 2), T.K. Bose, J. Kabir, P. Das, P.P. Joy (eds.), Naya Prakash: Calcutta; 123-125.

[2] Padmma M Paarakh. 2009 "Ficus racemosa Linn An-Overview". Natural Product Radiance. **8(1)**:84-90.

[3] Paarakh PM 2009. *Ficus racemosa* Linn.-An overview. Nat Prod Radiance, **8:** 84-90.

[4] Babu K, Hankar S G, Rai S. 2010. Comparative pharmacognostic studies on the barks of four *Ficus* species. Turkish J Bot., **34**:215-224.

[5] Agarwal S, Misra K. 1977. Leucoanthocyanins *Ficus racemosa* bark. Chemica Scripta. **12**:37-39.

[6] Suresh C, Jawahar L, Sabir M. 1979. Chemical examination of the fruits of *Ficus glomerata*. J Indian Chem Soc.**56**:1269-1270.

[7] Poongothai A, Sreena KP, Sreejith K, Uthiralingam M, Annapoorani S (2011). Preliminary phytochemicals screening of *Ficus racemosa* linn. bark. Int. J. Pharm. Biol. Sci. **2**:431-434.

[8] Simon CCF, Kouam SF, Poumale HMP, Simo IK, Ngadjui BT, Green IR, Krohn K 2008. Benjaminamide: A new ceramide and other compounds from the twigs of *Ficus benjamina* (Moraceae). Biochem. Syst. Ecol. **36**:238–243.

[9] Ogungbamila FO, GO Onawunmi, JC Ibewuike, KA Funmilayo 1997. Antibacterial constituents of *Ficus barteri* fruits. Pharm. Biol. **35**:185–189.

[10] Kengap RT, Kapche GDWF, Dzoyem J-P, Simo IK, Ambassa P, Sandjo LP, Abegaz BM, Ngadjui BT 2011. Isoprenoids and flavonoids with antimicrobial activity from *Ficus conraui* Warburg (Moraceae). Helvetica Chimica Acta **94**:2231–2238.

[11] Suresh A, Muthu G, Suresh G, Premnath R, Gopinath P, Mosesd A, Ramesh S 2012. Screening of antibacterial properties of Indian medicinal plants against multi drug resistant diabetic foot ulcer isolates. Int. J. Phytopharmacol. **3:**139-146.

[12] Murti K, Kumar U 2011. Antimicrobial activity of *Ficus benghalensis* and *Ficus racemosa* roots L. Am. J. Microbiol. **2**:21–24.

[13] Manimozhi DM, Sankaranarayanan S, Kumar GS 2012. Effect of different extracts of stem bark of *Ficus* sp. on multidrug resistant pathogenic bacteria. Int. J. Pharm. Sci. Res. **3**:2122–2129.

[14] Jahan F, Lawrence R, Kumar V, Junaid M 2011. Evaluation of antimicrobial activity of plant extracts on antibiotic-susceptible and resistant *Staphylococcus aureus* strains. J. Chem. Pharm. Res. **3**:777–789.

[15] V. P. Veerapur, K. R. Prabhakar, Vipan Kumar Parihar, Machendar Reddy Kandadi, S. Ramakrishana, B. Mishra, B. S. Satish Rao, K. K. Srinivasan, K. I. Priyadarsini, and M. K. Unnikrishnan 2009. *Ficus racemosa* Stem Bark Extract: A Potent Antioxidant and a Probable Natural Radioprotector. Evidence-Based Complementary and Alternative Medicine. **6(**3):317-324.

[16] Deraniyagala SA, Wijesundera RLC, Weerasena OVD. 1998. Antifungal activity of *Ficu sracemosa* leaf extract and isolation of the active compound. J
Nat SciCounc Sri Lanka. **26**:19-26.

[17] Vonshak A, Barazani O, Sathiyaamoorthy P, Shalev R, Vardy D, Golan GA. 2003. Screening of South Indian Medicinal Plants for antifungal activityagainst cutaneous pathogens. Phytother Res., **17**:1123-1125.

[18] Mahato RB, Chudary RP 2005. Ethnomedicinal study and antibacterial activities of selected plants of palpa district Nepal. Scientific World **3(3):**26–31.

[19] Ursula Weiss. Editorial Inflammation. Nature 454, (2008) 427.

[20] Singh Rk, Watal G 2010. Antimicrobial potential of *ficus bengalensis* aerial roots Int. J. Pharm. Biol. Sci. **1**:1–9.

[21] Li RW, Myers SP, Leach DN, Lin GD, Leach G, 2003. A cross-cultural study: anti-inflammatory activity of Australian and Chinese plants, J Ethno. Pharmacol., **85**:25-32.

[22] Viswanathan S., Thirugnanasambantham P., Reddy M. K., Narasimhan S., Subramaniam G. A. 1990. Anti-inflammatory and mast cell protective effect of *Ficus religiosa.* Ancient Sci Life. **10**: 122 – 125.

[23] Mandal SC, Maity TK, Das J, Saba BP, Pal M, 2000. Antiinflammatory evaluation of Ficusracemosa Linn. leaf extract, J Ethno. pharmacol, **72**:87-92.

[24] Li RW, Leach DN, Myers SP, Lin GD, Leach GJ,Waterman PG, A new anti-inflammatoryglucoside from Ficusracemosa L. Planta Med, **70**:2004, 421-426.

[25] Li RW, Myers SP, Leach DN, Lin GD, Leach G, 2003. A cross-cultural study: anti-inflammatory activity of Australian and Chinese plants, J Ethno. Pharmacol. **85**:25-32.

[26] Atique A, Iqbal M, Bhouse AKM. 1985. Ethnobotanical study of cluster fig. Fitoterapia, **56**:236-240.