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A Comprehensive Review on the Morphology and Pharmacological Properties of Ficus Racemosa Linn.

Mr. Sujal Pangare[1]*, Dr. Hemlata Dange[2], Dr. Vikas Shende[3], Ms. Sanchita Dhumal[4], Dr. Pramod Ingale[5] .

[1] *B Pharmacy Student, Dnyanvilas College of Pharmacy,Alandi,Pune,Maharashtra 412105,India*
[2] *Assistant Lecturer Department of Pharmacology, Dnyanvilas College of Pharmacy, Alandi,Pune,Maharashtra 412105,India*
[3] *Senior Lecturer Department of Pharmacology, Dnyanvilas College of Pharmacy,Alandi,Pune,Maharashtra 412105,India*
[4]*Assistant Lecturer Department of Pharmacology, Dnyanvilas College of Pharmacy, Alandi,Pune,Maharashtra 412105,India*
[5]*Principal at Dnyanvilas College of Pharmacy,Alandi,Pune,Maharashtra 412105,India*

A B S T R A C T

Medicinal plants have played a crucial role in healing traditions globally for centuries, as shown in historical writings such as the Vedas and the Bible. These plants contain abundant natural compounds with healing properties, serving as the basis of traditional medicine in many developing countries, and increasingly so in developed countries as well. Ficus racemosa Linn. (Moraceae), a large perennial tree native to tropical areas, exemplifies a medicinal plant with myriad applications. Commonly known as "gular," this species is highly esteemed in Ayurveda, where its various components are employed to address a wide array of health issues, including biliary disorders, jaundice, dysentery, diabetes, diarrhea, and inflammation. With over 700 species, the 'Ficus' genus is noted for its distinctive reproductive system and broad distribution across Asia, Africa, the Americas, and Australia. This review intends to offer a thorough examination of 'Ficus racemosa' by investigating its morphology, traditional uses, and pharmacological properties.

Keywords: *Ficus racemosa Linn. , Ayurveda, Traditional medicine, Biliary disorders, Jaundice, Dysentery, Diabetes, Inflammation, Ficus genus*

1.Introduction:

Medicinal plants have been used for healing purposes since ancient times in almost all cultures. The broad use of herbal treatments and health formulations, as seen in historical texts like the Vedas and the Bible, and stemming from commonly used traditional herbs and medicinal plants, can be attributed to the existence of natural substances with therapeutic properties.[12],[1] The use of traditional medicine and herbal plants in most developing countries, as a common basis for maintaining good health, has also been widely documented.[30],[1]Moreover, an increasing reliance on the use of medicinal plants in developed countries has been associated with the extraction and development of various medications and chemotherapeutics from these plants as well as from herbal remedies traditionally employed in rural settings.[31],[1]Ficus racemosa Linn. (Moraceae) is a perennial, spreading tree of moderate to large dimensions, yielding latex, and attaining a height of 15-18 m, without prominent aerial roots.[33],[1] Ficus is an unusually vast pantropical genus comprising more than 700 species,[3],[1] distributed broadly across the warmer areas of Asia, Africa, America, and Australia. It is classified as a single, large genus due to its clear separation driven by its unique reproductive system, which features syconia figs and specialized pollinator wasps.[22],[1]F. racemosa is commonly known as 'gular', and every component of this plant is deemed to have medicinal importance in Ayurveda; it has been extensively used in treating biliary disorders, jaundice, dysentery, diabetes, diarrhea, and inflammatory conditions.[6],[14],[21],[1].

In this review, a thorough overview of the morphology and pharmacological properties is provided in light of the numerous recent significant discoveries regarding this plant.

2.Taxonomy of Ficus Racemosa:

Synonyms:

Covellia glomerata (Roxb.) Miq. , Ficus glomerata Roxb. , Ficus vesca F. Muell. ex Miq. , and Ficus semicostata F. M. Bailey [8],[1].

Common names:

Gular fig, cluster fig, country fig, and redwood fig [13],[1].

Table 1 –Vernacular Names:

Language	Names
English	Cluster Fig, Redwood Fig
Hindi	Gular
Marathi	Umbar, Audumbar
Sanskrit	Udumbara
Chinese	Ju Guo Rong
Urdu	Dimiri
Kannada	Atti
Bengali	Dumur
Tamil	Atti

Table 2 – Taxonomical Classification:

Taxonomical Rank	Taxon
Kingdom	Plantae
Sub-Kingdom	Tracheobionata
Clade	Angiosperms
Clade	Eudicots
Clade	Rosids
Divison	Magnoliophyta
Sub-Division	Spermatophyta
Class	Equisetopsida
Sub-Class	Hamamelididae
Order	Rosales, Urticales
Family	Moraceae
Genus	Ficus
Species	Ficus Racemosa Linn.

Geographical Indication/Directions:

F. racemosa is not an epiphyte but is found across a vast region of India in moist areas, next to streams, at the edges of ravines, and sometimes on rocky hillsides, occasionally nearly in clusters. It is also found in Burma, China, Indonesia, Malaysia, and Australia.[8].[1] It is often cultivated near villages in India for its edible fruits.[7],[1].

3.Morphology:

F. racemosa is an evergreen, moderately large, spreading, latex-producing, deciduous tree, attaining heights of 15-18 m, lacking notable aerial roots.[33],[1] Young shoots can be glabrous, pubescent, or scaberulous, with leaves that are dark green, measuring 7. 5-15 by 3. 2-6. 3 cm, and may be ovate oblong or elliptic-lanceolate, narrowing to a bluntish point at the tip, presenting entire margins, and glabrous on both surfaces upon maturity, with the base either acute or rounded and possessing 3 nerves; lateral main nerves consist of 4-6 pairs; petioles measure between 1. 3-3. 8 cm in length, glabrous; stipules reach 2 cm in length, are ovate-lanceolate, scarious, and pubescent; fruit receptacles measure 2-5 cm in diameter, subglobose or pyriform, located in large clusters on short leafless branches that originate from the main trunk or larger branches. Figs can be either smooth or pubescent and are seldom covered with small soft hairs. When they mature, they display orange, dull reddish, or dark crimson hues with a depressed umbilicus (edible but often housing worms); there are 3 basal bracts shaped ovate-triangular; male, female, and gall flowers coexist in one receptacle, with male flowers forming a layer close to the receptacle walls while gall flowers constitute a more internal layer; the male flowers are sessile; there are 3-4 sepals that are membranous, inflated, and enveloping the 2 elongated ovate anthers; filaments are connate; gall flowers are pedicellate; the perianth

is gamophyllous, irregularly toothed, covering solely the base of the rough ovoid ovary; the style is lateral and elongated; the stigma is clavate; fertile flowers are subsessile; the perianth is gamophyllous, with 4 or 5 long lanceolate teeth surrounding the small minutely tuberculate achene; the style is sub-terminal; and the stigma is clavate.[14],[1] The fruits, produced in significant quantities, usually mature from March to July. Upon full ripening, they release a pleasing aroma reminiscent of cider apples. Often, they are infested with maggots from the fertilizing wasp, rendering them unsuitable for eating.[7],[1] The bark is astringent, rusty brown with a relatively smooth and soft texture; its thickness varies from 0. 5-2 cm depending on the age of the trunk or bark. The surface exhibits tiny separating flakes of a whitish substance, and its texture is consistently leathery.[33],[1].

Fig.[a] Unripe fruits/figs of *Ficus Racemosa Linn.*

Fig.[b] *Ficus Racemosa* Tree

4. Pharmacological Properties:

- **Hypoglycemic activity:**

Ficus racemosa demonstrates hypoglycemic activity; to assess this, an ethanol extract (250mg/kg/day, p. o.) is utilized, and the decrease in blood glucose levels was measured over two weeks. Alloxan-induced diabetic albino rats confirm hypoglycemic activity. The methanolic extract of the stem bark also exhibits glucose-lowering effects at doses of 200-400mg/kg, p. o. , with tests conducted on both normal and alloxan-induced diabetic rats. In comparison, this activity was measured against the standard antidiabetic agent glibenclamide at a dose of 10mg/kg, which also shows antidiabetic effects. B-sitosterol, isolated from the stem bark, proves to be more potent than other isolated compounds. The methanol extract of the fruit, administered at 1, 2, 3, and 4g/kg, reduces blood glucose levels in both normal and alloxan-induced diabetic rabbits. α-amyrin acetate, a significant component isolated from the fruits, is given at a dosage of 100mg/kg, which lowers blood glucose levels within 5 to 24 hours, yielding results of 18. 4% and 17. 0% in sucrose compared to the streptozotocin-induced diabetic rat model.[32],[1]

- **Antioxidant activity:**

The radical 1,1-diphenyl-2-picrylhydrazyl (DPPH) is utilized to assess antioxidant activity via the free radical scavenging technique. DPPH free radical is diminished when hydrazine interacts with hydrogen donors, resulting in stable DPPH molecules through the transfer of hydrogen. This method allows for an easy evaluation of the antiradical power of antioxidant activity through the reduction in absorbance of DPPH at 519nm. The color transitions from purple to yellow, indicating the discoloration of DPPH when the absorbance of methanolic extract of stem and leaves is measured at 517nm. The extract of stem and leaves was analyzed against the standard butylated hydroxytoluene (BHT) using the free radical scavenging method, and the extract exhibited antioxidant activity.[29],[1]

- **Hepatoprotective activity:**

The extract from the leaves and the extract from the stem bark demonstrate hepatoprotective activity in rats by causing chronic liver damage through the subcutaneous injection of 50% v/v carbon tetrachloride in liquid paraffin at a dose of 3ml/kg, administered on alternate days for 4 weeks. The dose

of stem bark extract administered was 250 and 500mg/kg, and all biochemical parameters, including SGOP, SGPT, serum bilirubin, and alkaline phosphate, were assessed and compared with the standard silymarin.[9],[1]

- **Antitussive activity:**

Methanol extract (200mg/kg) was evaluated alongside standard codeine phosphate (10mg) in sulfur dioxide gas-induced coughing in mice. The highest activity was observed 90 minutes after the administration of the bark extract, with a maximum inhibition of 56. 9%.[1]

- **Antidiarrheal activity:**

Ethanol extract of stem bark was analyzed in various experimental diarrhea models in rats. The inhibitory effect was noted against castor oil induced diarrhea, PGE2 induced enteropooling, and charcoal meal tests conducted in rats. Utilizing this extract on rats demonstrates antidiarrheal effects.[9],[1]

- **Antibacterial activity:**

Ficus racemosa extract in various solvents utilized as antibacterial, such as stem bark ethanolic extract found effective against Pseudomonas aeruginosa, Proteus mirabilis, Staphylococcus aureus, Bacillus cereus, Alcaligenes faecalis, and Salmonella typhimurium. Aqueous extract demonstrates activity against Streptococcus faecalis. Methanolic extract exhibits effects against Bacillus subtilis. Petroleum ether [23],[1]

displays effects against E. coli, Bacillus pumitis, Bacillus subtilis, Pseudomonas aeruginosa, and Staphylococcus aureus. Hydroalcoholic [9],[1] extract of leaves shows effects against Actinomyces vicosus at a minimum inhibitory concentration of 0.08mg/ml.

- **Wound healing property:**

The ability of F. racemosa to heal wounds is noted in various Ayurvedic texts, and a research study indicated that an ointment made from the powdered leaves combined with petroleum jelly (15% w/w) in an 8mm full-thickness punch wound rat model demonstrated a highly significant increase in tissue DNA (1. 73mg/g), RNA (1. 17mg/g), and total protein (16. 62mg/g) throughout the healing process when compared to untreated control rats.[4],[1]

- **Antipyretic activity:**

The methanol extraction from the bark given in doses of 200 and 300mg/kg bw showed a significant dose-dependent reduction in body temperature in both normal and yeast-induced fever in albino rats. The antipyretic effect of the extract was comparable to that of paracetamol (150mg/kg bw), a standard antipyretic drug.[24]. The extract and decoction of the leaves exhibited a significant antipyretic effect similar to that of indomethacin concerning yeast-induced fever in rats.[10].

- **Antifilarial activity:**

Alcoholic and aqueous extracts from the fruits of F. racemosa resulted in the suppression of spontaneous motility in both whole worm and nerve muscle preparations of Setaria cervi, which was characterized by a rise in the amplitude and tone of contractions. The concentrations necessary to inhibit the movement of the entire worm and nerve muscle preparations for the alcohol extract were 250 and 50 µg/mL, respectively, while for the aqueous extract, they were 350 and 150 µg/mL, respectively. Both alcoholic and aqueous extracts led to the mortality of microfilariae in vitro. The LC50 was 21 and 27 ng/mL, and the LC90 was 35 and 42 ng/mL, respectively, for the alcohol and aqueous extracts.[20].

- **Gastroprotective activity:**

Ethanol extract (50%) of the fruits demonstrated a dose-dependent decrease in ulcer index in pylorus ligation, ethanol, and cold-resistant stress-induced ulcers. The extract also protected the gastric mucosa by inhibiting lipid peroxidation and superoxide dismutase, H+K+ ATPase and increased the activity of catalase.[25]. The ethanol extracts from the bark and leaves of F. racemosa reduced the gastric volume, free acidity, total acidity, and ulcer index in rats with aspirin plus pylorus ligation-induced gastric ulcers and also diminished the gastric lesions caused by an HCl-ethanol mixture, indicating protection against ulcers induced by water immersion stress.[18].

The anti-ulcerogenic effect of 50% ethanol extract of unripe fruits of F. racemosa (100, 200, and 300mg/kg) was assessed in ethanol 4h pylorus ligation-induced gastric ulcer in rats. The extract showed significant antiulcer activity at all tested dosages, and the effect at 300mg/kg dosage was comparable to that of sucralfate (250mg/kg).[27]. A similar antiulcer effect comparable to that of sucralfate was exhibited by the methanol extract of unripe fruits of F. racemosa (100, 200, and 400mg/kg) in gastric ulcer models induced by aspirin and cold restraint stress.[28].

- **Larvicidal/Wormicidal activity:**

Assessed the larvicidal effectiveness of hexane, ethyl acetate, petroleum ether, acetone, and methanol extracts from the leaf and bark of F. racemosa against the early fourth instar larvae of Culex quinquefasciatus. The larval death was noted after 24 hours of exposure, and all the extracts demonstrated moderate larvicidal impacts, but the acetone extract from the bark exhibited the highest larval mortality. The larvicidal efficacy of F. racemosa was linked to the presence of gluanol acetate, which was also found to be highly effective against fourth instar larvae of Aedes aegypti L. , Anopheles stephensi L. , and C. quinquefasciatus.[26].The unrefined extracts of Ficus racemosa bark (petroleum ether, chloroform, ethanol, and water) tested for anthelmintic effects using adult earthworms showed a dose-dependent reduction in spontaneous movement (paralysis) and triggered reactions to pin-prick. Higher concentrations of the aqueous extract (50 mg/mL) resulted in irreversible paralysis, indicating the wormicidal properties of the extract.[5]

- **Analgesic activity:**

The analgesic properties of ethanol extracts from the bark and leaves were assessed using hot-plate and tail-immersion techniques. At a dosage of 300 mg/kg, i. p. , F. racemosa leaf extract significantly prolonged the latency time, providing approximately 40. 1% protection; the bark extract significantly extended the reaction time, offering 35% protection. The analgesic effects observed were attributed to the presence of friedelin, behanate, bergenin, lupeol, and lupeol acetate.[19] The decoction of F. racemosa leaves caused a significant reduction in the number of writhes in the acetic acid writhing test conducted on mice. A comparable effect was noted in the hot-plate test, where a significant analgesic effect was recorded, persisting for up to 3 hours following the administration of the decoction in mice. The petroleum ether extract displayed a notable anti-edemic effect in carrageenan-induced paw edema in mice.[10]

- **Anti-inflammatory activity:**

The anti-inflammatory activity of F. racemosa has been assessed in numerous studies. The petroleum ether extract of the leaves successfully alleviated the inflammation caused by histamine and serotonin, and the anti-inflammatory effect was credited to the anti-serotonin properties of the extract. Additionally, the extract diminished the edema triggered by dextran, which is known to be facilitated by both histamine and serotonin. [11]. The extract showcased notable anti-inflammatory activity in the cotton pellet assay, indicating its ability to decrease the rise in the number of fibroblasts and the production of collagen and mucopolysaccharide, which are natural processes that occur during granulation tissue formation.[2].The ethanol extract of the bark, frozen fruits, and the milky sap all displayed significant anti-inflammatory activity in vitro, evidenced by the inhibition of COX-1 at 89%, 71%, and 41%, respectively, at a concentration of 3. 4 mg/mL. n [16].In a different study, the ethanol extract of the bark demonstrated a considerable inhibition of COX-1, 5-LOX, and phospholipase A2 (PA2). The extract effectively obstructed the biosynthesis of PGE2 and PGD2 in the COX-1 assay, and the production of 5-HETE in the 5-LOX assay.[15]The petroleum ether extract of F. racemosa leaves at doses between 200-400 mg/kg bw showed significant anti-inflammatory activity in rat hind limb paw edema induced by carrageenan, serotonin, histamine, and dextran. The greatest effect was noted at the 400 mg/kg dose. In chronic tests, at 400 mg/kg, the effect was comparable to that of phenylbutazone, a non-steroidal anti-inflammatory drug [17].

5. Conclusion:

The review article presents an in-depth examination of the morphology, taxonomy, and extensive pharmacological properties of Ficus racemosa Linn., a highly esteemed medicinal plant in Ayurveda. It emphasizes its uses in addressing various health issues such as diabetes, inflammation, and biliary disorders, while also illustrating its extraordinary antioxidant, anti-inflammatory, antidiarrheal, and gastroprotective effects. This thorough analysis strengthens the therapeutic importance of Ficus racemosa Linn. and its potential for additional research and advancement in contemporary medicine.

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