

THERAPEUTIC POTENTIAL OF FICUS RACEMOSA: A COMPREHENSIVE REVIEW OF PHYTOCHEMISTRY AND PHARMACOLOGICAL ACTIVITIES

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ABSTRACT

Ficus racemosa Linn. (Cluster fig/Gular), which belongs to the family Moraceae, is an extensively used medicinal plant that is popularly known for its medicinal uses in India. This plant has been utilized over the centuries as a medication in the handling of numerous diseases, including diabetes, liver illnesses, diarrhea, inflammation, and hemorrhoids, among others. This comprehensive review discusses the several phytochemical constituents present in different portions of *F. racemosa* (such as bark, leaves, fruits, and latex) and highlights its broad spectrum of pharmacological activities. Phytochemical investigations have identified several bioactive compounds responsible for antioxidant, anti-inflammatory, antidiabetic, antimicrobial, hepatoprotective, and other health-promoting properties. The review emphasizes traditional uses, phytochemical profile, and mechanism of anticancer activity of *F. racemosa*.

KEYWORDS- *F. racemosa*, traditional uses, anti-cancer activity, phytochemicals, therapeutic uses.

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INTRODUCTION

Cancer is a large group of diseases with prominent uncontrolled proliferation, which is not balanced by cell death [1]. It starts with the conversion of a healthy cell to a controlled growing cell called a tumour. The cancer-causing factors are alcohol, obesity, overweight, tobacco, and pollution. The common symptom of cancer is uncontrolled cell growth, a hard area, an ulcer, low-grade fever, and loss of weight [2]. The current estimate of cancer worldwide is approx. 20 million+ new cases, which will double by 2070. This global growing burden needs urgent, actual inhibition, dealing, and healing policies in contradiction to this composite disease.

Whereas chemo, surgery, and radiation have several side effects and limitations. Throughout history, several plants have medicinal properties to improve health outcomes. Medicinal plants claim the roots, hepatitis C virus (HCV), heavy drinking, intake of aflatoxins, obesity, NAFLD, and cirrhosis [2]. Liver cancer is a serious type of malignancy that usually starts in the liver and is strongly linked with viral infections such as hepatitis B and C viruses. The hepatitis B virus can be spread to another individual by coming into interaction with ill plasma, semen, and additional physical liquids. As a result, there will

leaves, and fruits, in tradition, contribute a preliminary opinion for plants with bioactive mixtures and healing belongings [3].

According to the International Agency for Research on Cancer (IARC), which is a particular cancer research organization below the World Health Organization (WHO), liver cancer has become one of the most important worldwide health problems and is the additional major reason of death due to cancer around the world today. This is because liver cancer has a very high death rate, which is mainly due to the aggressive nature of the condition, its asymptomatic state in the early stages, and the lack of efficacy in current treatment regimens after the disease reaches an advanced stage. Some of the chief risk issues for liver cancer comprise long-lasting contagion with the hepatitis B virus (HBV) or the be increased chances of chronic liver disease as well as the development of liver cancer [4]. There are several histological classifications of liver cancers, namely hepatocellular carcinoma (the most common form), cholangiocarcinoma, hepatoblastoma (mainly occurs in children), and the rare and extremely dangerous angiosarcoma [2].

Based on various epidemiologic studies, chronic hepatitis due to viruses is still the greatest shared reason of liver cancer universal. Around 56% of liver cancers are found to be linked to HBV infection, while about 20% can be associated with HCV infection. Apart from the presence of viral hepatitis, some other important risk factors that play a part in the pathogenesis of the illness are related to

Figure 1 *F. racemosa* tree with aerial parts

HCC (hepatocellular carcinoma) is a main reason of death due to cirrhosis of the liver. The HCC has increased in the last 40 years, and associated mortality is still increasing in the US and Canada, mainly due to hepatitis C [6]. In relation to HCC patients being monitored in hepatoma clinics, abdominal distension was seen to be the most common symptom at 76%. Other symptoms of HCC included weight loss (4.4%), gastrointestinal bleeding (4.4%), and jaundice (2.6%) [7]. HCC makes up about 85%–90% of all cases of primary liver cancers, which is considered to be the second major cause of death from cancer in the world, with close to 700,000 people losing their lives annually due to this disease [8]. Plants have been secondhand

the lifestyle of individuals. For instance, tobacco use and smoking have been found to account for almost 18% of liver cancers, while heavy alcohol consumption causes around 17% of these tumors [5]. Both these factors can cause inflammatory changes to liver tissue and may eventually induce cellular malignancy.

to prevent and treatment numerous types of diseases as medicines since the beginning of time. Plants have medicinal significance that has been proven by ancient Indian medicine systems such as the Rigveda and Ayurveda. The leaves, fruit, bark, roots, latex, and sap of medicinal plants are significant in treating illnesses due to the bioactive components present in them. Plants are considered vital in managing many health problems, and they are the source of developing modern drugs since they are efficacious, readily available, and relatively safe to use [9].

According to the WHO (World Health Organisation), 80% of the biosphere's populace usage botanic medicines for their main health care [10].

Figure 2 *F. racemosa* tree with aerial parts

Whereas, *Ficus racemosa* is moderate evergreen plant well known for its medicinal properties. *Ficus racemosa* a large genus with over 700 species dispersed extensively through the tropical regions of Asia, Africa, America, and Australia [10]. Several species of the *Ficus* genus are *Ficus racemosa*, *Ficus benghalensis*, *Ficus microcarpa*, and *Ficus religiosa*, etc. Among them, *Ficus racemosa* is most

properties [11]. *Ficus racemosa* belongs to the family

Moraceae are normally grown as an average to huge, evergreen bush that grows to 18m tall [12]. *Ficus racemosa* is also recognized as cluster fig, gular, cluster tree, and gular tree. The plant has various parts, including bark, leaves, roots, and fruit [13]. They consist of hepatoprotective, antidiarrheal, anti-



popular with its many therapeutic and medicinal

inflammatory,

antipyretic,

antifungal,

uncontaminated, hypolipidemic, antilarial, and anticancer properties [14].

ETHNOMEDICINAL PROPERTIES

Medicinal plants, meanwhile, in ancient eras, have remained rummage-sale by all philosophies as a foundation of medicines. The ancient system of medicine describes the traditional use of plants in the Vedas and the Bible, and it is known that traditional plants have their medicinal properties [15].

Whereas more than 25,000 herbal preparations are in medicinal texts, and whereas 25% modern drugs are isolated from plants [19]. Since ancient times, Ficus is a type with 800+ species and 2000 varieties [16].

Ficus racemosa is a moderate evergreen plant spreading all over India. Usually recognized as cluster fig in English, Goolar in Hindi, and Udumbara (Udumbara is considered sacred to God Datta guru). It is a deciduous tree with 15-18 feet high. It is innate to India, Asia, Australia, Malaysia, South Africa, and other subcontinents of India [16].

Ficus racemosa is a vital plant used in various traditional medicinal practices for treating numerous ailments. The plant is among the most recognized

plants listed in several old medicinal books in the practices of Ayurveda, Siddha, Unani, and Homeopathy medicines. This medicinal plant contains diverse medical properties, which have made it popular in different traditional healing practices. The majority of the *Ficus racemosa* parts, such as leaves, bark, roots, latex, and milky sap, are utilized for medicinal purposes. These various parts contain multiple biological components with antioxidant, anti-inflammatory, antimicrobial, antidiabetic, hepatic protective, and coiled curative properties [17].

Moreover, the healing position of the old-style scheme of drugs in India lies in the handling of piles, dysentery, asthma, gonorrhoea, menorrhagia, leucorrhoea, haemoptysis, and urinary disease. Although various research said that it is biologically active for hepatoprotective, anti-diuretic, antipyretic, and antitussive [18]. All parts of the plants, similar leaves, bark, roots, latex, and milky sap, have their own medicinal properties [17].

Table 1 Traditional uses of *F. racemosa*

Sr.no.	Parts of a plant	Extraction process	Medicinal uses	References
1.	Leaves	Decoction	Douche, dysmenorrhea, wound, ulcer	[21], [20]
		Mixture with honey	Bilious infection	
		Juice	Prevent Hair Splitting	
2.	Leaf latex	-	Boils, blisters, measles	[22], [20]
3.	Fruit	-	Astringent, stomachic, diarrhoea, constipation, diabetes.	[23]
		Juice	Menorrhagia and haemoptysis	
4.	Fruit and Bark	-	Leprosy	[23], [20]
5.	Bark	Infusion	Spongy gums, dysentery, menorrhea, haemoptysis, diabetes, UTI	
		Decoction	Asthma and piles	
		Paste	Burns, swelling, leukorrhea, dysentery, diarrhoea	
6.	Root sap	-	Gonorrhoea, diabetes, mumps, heat stroke	[20]
7.	Latex	-	Preparation of an aphrodisiac drug to boost the fertility system To treat mumps, cholera, and stomach Skeletal fracture	[9] [23]

Table 2 Traditional uses of *F. racemosa* in different countries

Country	Traditional uses	References
India	Diabetes, diarrhea, wound healing	[15]
Sri Lanka	Anti-inflammatory, liver disorder	[28]
Nepal	GIT disorder	[25]
China	GIT, Gynaecological bleeding conditions, anti-inflammatory	[24]
Bangladesh	Dysentery, skin diseases	[26]
Thailand	Dysentery, pyresis, and antimicrobial	[27]

BOTANICAL OVERVIEW

Plant profile

Ficus racemosa is an imposing and attractive fig tree, known for its rough bark, bent trunk, and wide-spreading crown. The notable characteristics of this plant include the presence of reddish figs in dense clusters, which appear directly on the trunk and large branches. This species is highly prevalent and can be seen in many villages, towns, and cities, growing wild as well as cultivated due to its medicinal value and significance in culture [29].

Ficus racemosa is an evergreen plant that belongs to the family Moraceae. It is an innate plant of Australia, Asia, Malaysia, South-East, and the Indian subcontinent [17] [25], widely distributed in India after the Himalayan varieties, Bihar, Rajasthan, Orissa, West Bengal, and South India. The *Ficus racemosa* tree bears several common names in different tongues. In English, the tree goes by the common names of the cluster fig and gular fig since its fruit grows in dense clusters at the base of the tree and its branches. The most common names

that it is known by in Hindi and Sanskrit are gular and udumbara, respectively. The latter name is often mentioned in ancient Ayurvedic literature. *Ficus racemosa* has been widely used for generations due to its many medicinal uses [30].

The plant *Ficus racemosa* is well distributed all over India and is very common in forests, hills, and plains. It is adapted to the climate of tropical as well as subtropical zones and is usually seen along rivers and near water streams, as well as in places where there is adequate availability of water. Apart from its spontaneous growth in nature, *Ficus racemosa* is grown artificially in several parts of India because of its importance in medicine, ecology, and economy. This plant blooms in well-drained medium to heavy soils, avoiding waterlogged or clay types. It propagates via stem cuttings, root suckers, or seeds, with flowers pollinated by tiny birds. Leaves stay evergreen near water but shed in January. Children traditionally use their figs to join thin sticks for playful shapes [31].

Taxonomical Classification

Table 3 Taxonomical classification [31], [32], [33]

Empire	Plantae
Partition	Magnoliophyta
Order	Rosales
Class	Magnoliopsida
Intimate	<i>Moraceae</i>
Genus	<i>Ficus</i>
Species	<i>Ficusracemosa</i>
Synonym	<i>Ficus glomerata</i>
Phylum	Spermatophyta

Subphylum	Angiospermae
Domain	Eukaryote
Common name	Udumbara, Gular fig, Cluster Fig, Goolar Fig, Country Fig

Vernacular names

Table 4 Vernacular terms of *Ficus racemosa* [16] [17] [35]

Language	Names
Sanskrit	Udumbara, Jantu phala, Yajnayoga, Gular, Sadaphalah, Saumya
Hindi	Gular, Pani bhuj, Umari, Dumar
English	Gular fig, cluster fig, nation fig, redwood fig
Bengali	Udumbara
Telugu	Atti
Gujrat	Goolar, Umbaro
Urdu	Dumar
Nepal	Dumrii
Kannada	Atti, Atti mara
Tamil	Malaiyin munivan

Morphological characteristics

Ficus racemosa plants are oval to ovate-lanceolate in form, which are 7.5-10 cm in length and up to 20 cm in breadth, with a dark green colour. They contain flavonoids, alkaloids, and tannins, and are used to treat jaundice and diarrhoea. Its bark covers a bole buttressed and having 30 m in height, with 8-10 mm thickness, and the surface is reddish brown,

smooth, coarsely flaking, and fibrous. The outside surface of the bay is simply changeable. Fruits are pear-shaped with a 25cm diameter; fruits are green when raw and red after ripening. Seeds are tiny. Roots are bitter in taste with a characteristic odour and long, brownish in colour [35] [36].

Phytochemical Potential of *F. Racemosa*

Table 5 Phytochemical and pharmacological abilities of *F. racemosa*

Sr. No.	Plant Part	Major Phytochemicals	Pharmacological Activities
1	Roots	Cycloartenol, Flavonoids, Coumarins, Tannins, Saponins, Alkaloids, Steroids	Antioxidant, Anti-inflammatory, Antidiabetic, Hepatoprotective, Antimicrobial, Wound-healing
2	Stem	Campesterol, Hentriacontane, Hentriacontanol, Kaempferol, Stigmasterol, β -Sitosterol, α -Amyrin acetate, Glauanol acetate	Astringent, Anti-inflammatory, Hypoglycemic, Antidiarrheal, Anti-ulcerative, Anti-asthmatic, Antipyretic, Wound-healing
3	Leaves	Tetratriterpene, Fluoroacetate, Racemosic acid, Oleanolic acid, Glycosides, Flavonoids, Tannins	Antifungal, Antibacterial, Anti-inflammatory, Wound-healing, Hepatoprotective, Cytotoxic
4	Fruits	Glauanol, Hentriacontane, β -Sitosterol, Glauanol acetate, Lupeol acetate, Friedelin, Phytosterols, Tannins, Steroids, Flavonoids	Astringent, Hypolipidemic, Antidiabetic, Anticarcinogenic, Antileucorrhoeal

5	Latex	α -Amyrin, Cycloartenol, Cycloeucalenol, 4-Deoxyphorbol, Euphorbinol, Palmitic acid, Taraxerol, Trimethylellagic acid	Antipyretic, Anti-inflammatory, Antimicrobial
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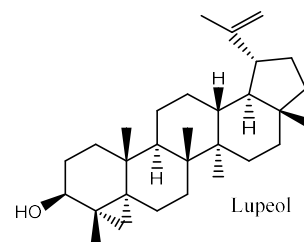
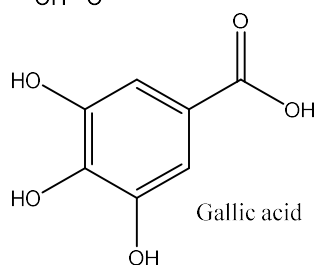
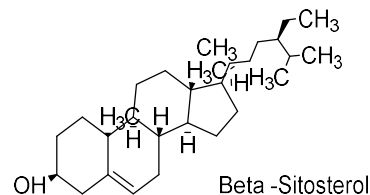
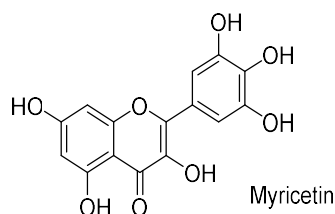
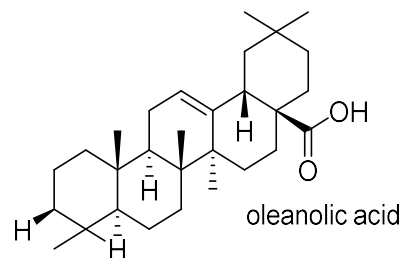
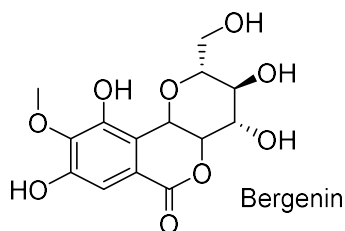
F. racemosa plant has many phytoconstituents, including gallic acid, ellagic acid, quercetin, kaempferol, leucocyanidin, lupeol, oleanolic acid, α -amyrin, β -sitosterol, stigmasterol, campesterol, cycloartenol, friedelin, racemosic acid, and taraxerol. Due to these phytochemicals, it exhibits

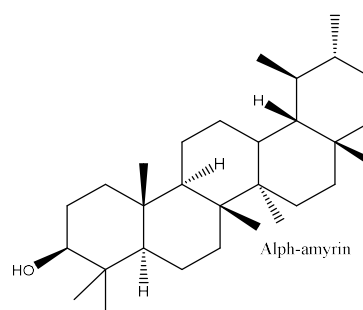
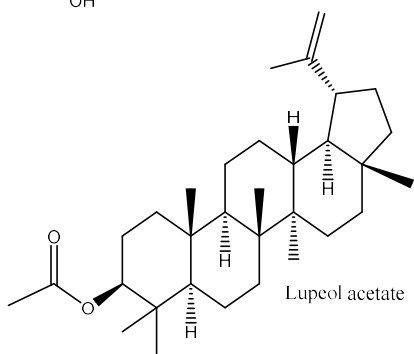
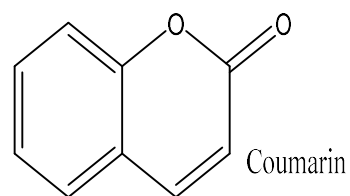
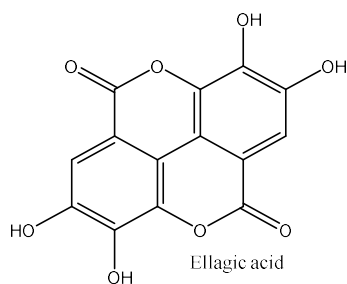
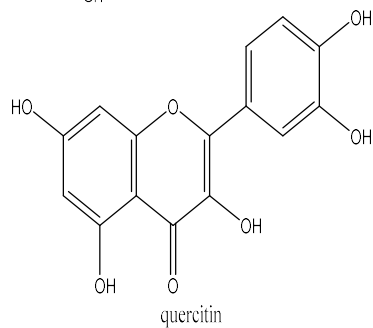
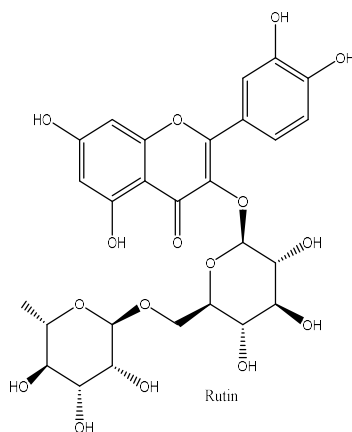
several pharmacological properties, including anti-diabetic, anti-inflammatory, cytotoxic, hepatoprotective, antimicrobial, antipyretic, antifungal, anti-asthmatic, anti-ulcer, antibacterial, and wound-healing activities, as shown in Table-3 [37-40].

Phytochemistry

Phytochemical study of *Ficus racemosa* reveals a secondary metabolite distributed across dissimilar portions of the shrub. The bark contains β -amyrin, lupeol acetate, bergenin, lupeol, β -sitosterol, and tannins. Although the greeneries cover flavonoids such as quercetin and kaempferol, rutin, arabinose, bergapten, then ficusin. The fruits are rich in

phenolic acids like gluanol acetate, hentriacontane, tiglic acid, gallic and ellagic acids, along with triterpenoids and sterols. The active chemical constituents show activity towards several diseases, such as anti-diabetic, anti-inflammatory, anti-malarial, anti-cancer, hepatoprotective, and anti-oxidant [32][42][52].





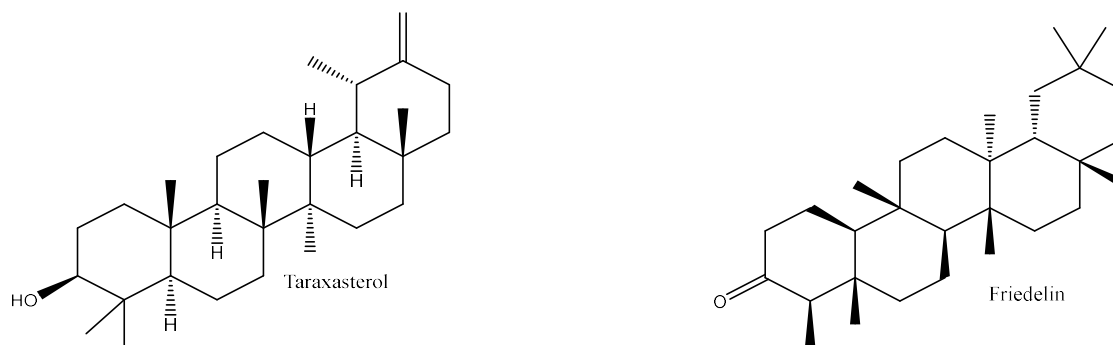


Figure 3 Phytochemistry of *F. racemosa*

PHARMACOLOGICAL ACTIVITY

Table 6 Pharmacological activity of *F. racemosa*

Sr.No.	Pharmacological activity	Extraction	References
1.	Anti-bacterial	Hydroalcoholic extraction of leaves active against <i>Actinomyces viscosus</i> .	[23][32]
		Methanolic extract shows activity towards Gram-positive bacteria.	[42]
2.	Anti- diuretic	Decoction of bark shows an anti-diuretic effect	[23], [32]
		Methanolic fruit extract of <i>F. racemosa</i> reduces blood glucose level in mice.	[48]
3.	Anthelmintic	The aqueous extract showed wormicidal activity	[48], [43], [23].
4.	Antipyretic	The methanol extract of <i>Ficus racemosa</i> stalk bark reveals considerable antipyretic activity, which acts to decrease the increased body temperature.	[64], [65]
5.	Wound healing	Alcoholic and aqueous extracts of <i>Ficus racemosa</i> are wound healing agents. It has been discovered that an aqueous extract is more efficient in wound contraction compared to the ethanolic extract.	[44] [49]
6.	Antidiarrheal	The ethanolic extract of <i>Ficus racemosa</i> stem bark has exhibited antidiarrheal activity by inhibiting the movement of the intestines and fluid production.	[32]
7.	Anti-inflammatory	Ethanolic extracts of the stem bark and leaves of <i>Ficus racemosa</i> have proved to be significantly anti-inflammatory. These ethanolic extracts have proved to reduce inflammation and have been helpful in the cure of ulcers and inflammatory ailments.	[41][46][50]
8.	Hepatoprotective	Ethanolic extracts of the stem bark and leaves exhibit analgesic (pain-relieving) properties. This has been confirmed by the study conducted using the algometer studies. Furthermore, the extract obtained from the fruits of <i>Ficus racemosa</i> has proven effective in treating both peripheral and central pain.	[23][44]
9.	Analgesic	<i>Ficus racemosa</i> extracts have strong antifungal properties. These extracts have been proven effective against several pathogenic fungi such as <i>Trichophyton mentagrophytes</i> , <i>Trichophyton rubrum</i> , <i>Trichophyton soudanense</i> , <i>Candida albicans</i> , <i>Candida krusei</i> , and <i>Torulopsis glabrata</i> .	[23][32] [50]

10.	Anti-fungal	Extract inhibited the growth of six fungi, i.e. <i>Trichophyton mentagrophytes</i> , <i>Trichophyton rubrum</i> , <i>Trichophyton soudanense</i> , <i>Candida albicans</i> , <i>Candida krusei</i> , and <i>Torulopsis glabrata</i>	[45][32][42]
11.	Anti-cancer	Extract of <i>F. racemosa</i> shows an inhibitory effect against DNA topoisomerase-II, which inhibits intracellular DNA synthesis	[41]
		Methanolic fruit and leaf extract of <i>F. racemosa</i> has cytotoxic activity using the brine shrimp lethality bioassay	[36]
		Leaf extract reduces cancer viability	[47]
12.	Anti-oxidant	The ethanolic extract of <i>Ficus racemosa</i> displays advanced antioxidant activity than the aqueous extract. The roots show strong antioxidant activity, which is shown using DPPH, hydroxyl, and hydrogen peroxide scavenging capacities.	[41],[3],[36]
13.	Anticholinesterase	Anticholinesterase activity has been observed for cold and hot water extracts of <i>Ficus racemosa</i> bark because of a reduction in cholinesterase content in the rat brain.	[58]
14.	Anti-fungal	<i>Ficus racemosa</i> demonstrates remarkable antifungal activity against several fungal species, such as <i>Trichophyton mentagrophytes</i> , <i>Trichophyton rubrum</i> , <i>Trichophyton soudanense</i> , <i>Candida albicans</i> , <i>Candida krusei</i> , and <i>Torulopsis glabrata</i> .	[40], [37]

Anti-bacterial activity

The hydroalcoholic extract of leaves shows significant antibacterial action compared to the bacterium *Actinomyces viscosus*, a Gram-positive bacterium associated with oral and periodontal infections [23][32][42].

Anti-diuretic activity

The decoction of bark demonstrates antidiuretic effects. It is possible by reducing urine output and modulating electrolyte balance. This activity may involve interaction with renal tubular reabsorption mechanisms, suggesting its traditional use in managing excessive urination [23][32]. High levels of antidiabetic properties have been shown by the methanolic extract from the fruits of the plant *Ficus racemosa* in laboratory-induced diabetic rats. Administration of the extract in amounts of 300 mg/kg body weight and 500 mg/kg body weight caused a lowering of blood glucose, showing its ability to be used in the treatment of diabetes mellitus. It can be due to the active substances contained in the extract, such as flavonoids and tannins [48].

Anthelmintic activity

The aqueous extract possesses anthelmintic activity with notable wormicidal properties. The existence of tannic acid and saponins may contribute to this effect by causing paralysis or death of worms through disruption of their metabolic and neuromuscular systems [48][43][23].

Anti-pyretic

The methanolic extract of the bark of *F. racemosa* was tested on body temperature and yeast-induced fever in rats, at oral doses of 100, 200, and 300

mg/kg of weight of albino rats. This results in a reduction of usual body temperature. And yeast-induced rat raised temp. and it lasts up to 5 hours after drug administration. It acts the same as PCM [64] [65].

Wound healing activity

Alcoholic and aqueous extracts have shown wound healing potential, including activity against microfilariae. The activity may be linked to enhanced collagen synthesis, antimicrobial action, and antioxidant properties that promote faster tissue regeneration and reduced inflammation [44][49].

Antidiarrheal activity

The ethanolic extract of the stem bark reveals antidiarrheal activity. The castor oil-induced diarrhoea rat model was induced by the *F. racemosa* extract, which decreases the number of wet fecal droppings and reduces the frequency of defecation. This possibly reduces intestinal motility and inhibits secretion. [32].

Anti-inflammatory activity

The ethanolic extract of the stem bark and leaves of *Ficus racemosa* exhibits remarkable anti-inflammatory properties. The extract is beneficial in reducing inflammation, especially for conditions like ulcers [41][46][50].

Hepatoprotective activity

The ethanolic extract of leaves shows hepatoprotective effects. Carbon tetrachloride induces hepatotoxicity in rats, which was treated by the methanolic extract of stem bark, which meaningfully concentrated the liver enzymes AST, ALT, and ALP. The extract lowers the bilirubin, restores protein and albumin, and improves

antioxidant status by reducing (TBARS), which increases glutathione (GSH) [23][44].

Analgesic activity

It has been observed that the ethanolic extracts from the bark and leaves of *Ficus racemosa* exhibit considerable analgesic activity in animals, and this has been confirmed by experiments involving an analgesimeter. Studies show that these plant extracts have the potential to inhibit pain sensation and enhance pain resistance in animals. This analgesic activity has been attributed to a mechanism operating at both the peripheral and central levels. At the periphery, it is believed that the extract has the ability to overpower the production or release of provocative agents like prostaglandins that cause pain. At the central level, these bioactive compounds might act on nerve pathways involved in pain perception to suppress pain sensations [23][32][50].

Antifungal activity

Ficus racemosa extract exhibits potent antifungal properties against various pathogenic fungi, such as *Trichophyton mentagrophytes*, *Trichophyton rubrum*, *Trichophyton soudanense*, *Candida albicans*, *Candida krusei*, and *Torulopsis glabrata*. The action of antifungals is due to bioactive compounds that inhibit fungal proliferation. Based on this evidence, one can argue that *Ficus racemosa* holds potential as a natural source for treating fungal infections [45][32][42].

Anti-Cancer Activity

The methanolic extract of fruit and leaf having cytotoxic potentials using the saline prawn death

bioassay, and both extracts results in dose-dependent cytotoxic activity [41]. The extract demonstrates anticancer activity by inhibiting DNA topoisomerase II, thereby suppressing intracellular DNA synthesis [46]. The leaf extract of *Ficus racemosa* has anti-cancer activity, which shows anti-proliferative activity on cells. According to this article, the leaf extracts reduced cancer viability and increased ROS, which leads to depolarization of the mitochondria and results in inhibition of cell proliferation. Also, activate caspase 3, which results in apoptosis [52].

Anticholinesterase

This study evaluated the cold and hot water extracts of the bay of *F. racemosa* on rat brain acetylcholinesterase in the laboratory. Both hot and cold aqueous extracts showed activity towards the acetylcholinesterase in the lab. Cold and hot water extracts showed dose-dependent reduction in rat brains [62].

Anti-oxidant activity

The methanolic extract of the leaf and fruit of *F. racemosa* showed strong free radical scavenging ability in multiple assays (DPPH, superoxide, hydroxyl, and hydrogen peroxide scavenging [36]. The ethanolic extract exhibits stronger antioxidant action likened to the aqueous extract, under steady-state conditions. This improved action may be due to advanced concentrations of polyphenols, flavonoids, and tannins that scavenge free radicals and reduce oxidative stress [46][47][48].

CELLULAR MECHANISM

Table 7 Cellular mechanism

Sr. No.	Activity	Mechanism	Effect	References
1.	Anti-oxidant	Nrf2–ARE Pathway, increase (SOD, CAT, GPx, GSH),	Reduce oxidative damage to the cell as well as tissue	[53],[61]
2.	Anti-inflammatory	NF-κB pathway inhibition	Reduce prostaglandin and nitric oxide production	[54],[62]
3.	Anti-cancer	Increase Bax, decrease Bcl-2, activate caspase-9 to caspase-3	Induce apoptosis	[59]
4.	Hepatoprotective	Hepatocyte cell membrane, detoxification enzymes	Protects liver tissue	[60]
5.	Anti-diabetic	Pancreatic beta cells, carbohydrate-metabolizing enzyme	Reduce hyperglycaemia-induced oxidative damage	[55],[56]

6.	Anti-microbial	Microbial cell wall	Inhibit microbes, bacteria, fungus	[57],[58]
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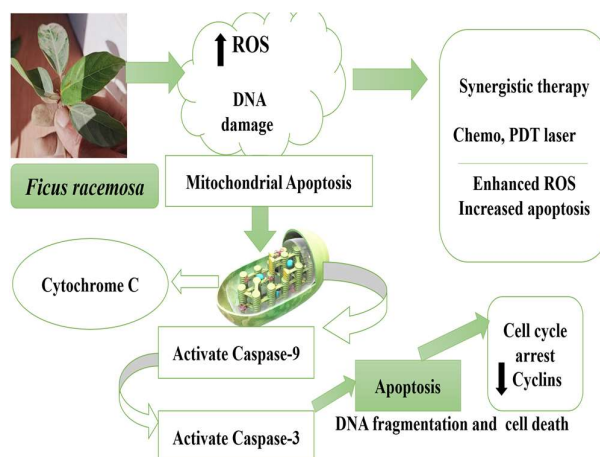


Figure 4 Cellular mechanism of Anti-cancer activity [66]

HERBAL FORMULATION OF *F. RACEMOSA*

Herbal ointment

Ethanol extract of *F. racemosa* is effective against bacteria, i.e., *S. aureus*, and *E. coli*, and less so against *Klebsiella spp.* Therefore, *F. racemosa* is effective against wound microorganisms. As per this article, they formulated the gel from the ethanol extract of *F. racemosa*.

Therefore,

The gel was formulated by the ethanol leaf extract of *F. racemosa*, showing antibacterial activity towards three bacterial strains using the zone inhibition method. The gel shows the highest antibacterial activity towards *Staphylococcus aureus* bacteria through a 19 mm zone of inhibition. Uniformly, *E. Coli* shows moderate activity with a 14 mm zone of inhibition. As per this, lower activity is shown towards the *Klebsiella* species with a 12 mm zone of inhibition. This observation reveals that the gel prepared from the leaf extract of *Ficus racemosa* shows higher antibacterial efficacy against Gram-positive bacteria than against Gram-negative bacteria. Higher susceptibility of Gram-positive bacteria to the gel may be because of variations in their cell walls, rendering them more susceptible to the biologically active components found in the leaf extract. These observations show that the leaf extract of *Ficus racemosa* has great potential for use as an antibacterial agent against Gram-positive bacterial infections [67].

Herbal tea

The tea formulated by drying the *F. racemosa* (fig) at different temperatures shows antioxidant and anti-diabetic activity. *F. racemosa* has secondary metabolites that are a useful source of antioxidants, which contain flavonoids, alkaloids, saponins, tannins, and steroids.

Therefore,

The result of phytochemical analysis showed that various pharmacologically active constituents were present in the fruit extract of *Ficus racemosa*, and most of them have known antioxidant and antidiabetic properties. The presence of such phytoconstituents increases the medicinal value of this particular plant. The fruit extracts of *Ficus racemosa* dried at 50°C, 60°C, and 70°C temperatures contained these active compounds. The moisture content is 9.11, 5.50, 4.65, and the pH value is 6.13, 5.64, 5.59, respectively.

Along with these, the *F. racemosa* (fig) herbal tea formed as a natural, functional health drink with several anti-diabetic benefits [68].

Nutra tea

Nutra tea formulated by *F. racemosa* bark has nutritional value and several phytochemical characteristics for developing a functional beverage. Analysis revealed the presence of carbohydrates, dietary fibre, and a moderate amount of minerals. Therefore, having moisture content, ash value, extractive values, pH of infusion, and solubility.

Therefore,

The *F. racemosa* bark is utilized in the formation of Nutra tea. With low cost, plant-based functional beverages, *F. racemosa* bark is used as an ingredient in Nutra tea [69].

Derma stick

Medicated derma sticks formulated and evaluated by the extract of *Ficus racemosa* to treat the infectious skin disease as an antibacterial activity. A derma stick prepared with *Ficus racemosa* extract was tested for its antimicrobial effect on *S. aureus*, *E. coli*, and *C. albicans*. It showed satisfactory physical stability and drug loading, making it fit for topical use. The antimicrobial effect on these bacteria indicates that *Ficus racemosa* can be an effective tool in managing various skin infections.

Therefore,

The prepared medicated derma stick is used for the topical application for the healing of infectious diseases [70].

Herbal gel

Herbal gel formulated and evaluated by the ethanolic extract of leaves, fruit, and bark of *F. racemosa* to treat ulcer, as each has its anti-ulcer and anti-microbial activity. This herbal gel was evaluated for anti-microbial and anti-bacterial activity. Which reduce gastric acid-induced mucosal damage, promote epithelial regeneration, and tissue repair. The prepared medicated gel has organoleptic properties, the best pH for topical use, suitable viscosity, and good spreadability.

Therefore,

The prepared medicated herbal gel used for the mouth ulcer shows anti-ulcer activity [71].

Herbal tea

The fruit of *F. racemosa* has several properties, one of which is anti-oxidant due to the phytochemicals present in the fruit of the plant. According to this study, *F. racemosa* fruit was evaluated for its phytochemicals when used as an herbal tea. This identifies on the basis of the flavonoids and phenolic content of the fruit at dissimilar temperatures, similar to 50°C, 60°C, 70°C.

Therefore,

Drying fruit at 60°C raises a balance between phytochemicals and anti-oxidant effect and taste of the consumer, and this holds a herbal tea, along with anti-oxidant properties and good taste [72].

Tablet formulation

F. racemosa methanolic bark extract has several pharmacological properties like anti-oxidant, anti-pyretic, and anti-inflammatory. The methanolic bark extract of *F. racemosa*, combined with several pharmaceutical excipients, forms a tablet by the wet granulation method 250g compressed tablet is formulated by this technique. Therefore, the formulated tablet is used as a solid dosage showing anti-pyretic activity [73].

Foot cream

Leaf extract of *F. racemosa* has several phytochemical constituents that are used as a moisturising agent and are useful in the formulation of herbal foot cream for cracked heels. According to this article, the herbal extract has antibacterial and anti-inflammatory properties, which are stable in polyherbal crack cream.

Therefore,

Several plant extracts are used in the formulation of moisturising creams and crack cream for the feet. The formulation was formulated to ensure skin compatibility, stability, and therapeutic efficacy [74].

Conclusion: *Ficus racemosa* is one of the most important medicinal plants and has high medicinal potential due to its long usage in the field of traditional medicine, along with pharmacologically

verified benefits. Various types of phytoconstituents like flavonoids, tannins, triterpenoids, saponins, alkaloids, glycosides, and phenols exist in *Ficus racemosa*, which are the reasons behind its wide array of medicinal properties. Several scientific investigations reveal that the plant possesses antidiabetic, antioxidant, anti-inflammatory, antimicrobial, anticancer, analgesic, hepatoprotective, antifungal, and wound-healing properties.

Several portions of the plants, including the roots, bark, leaves, fruits, and latex, have been studied extensively and have been found to exhibit considerable biological activity. This implies that the species is a good candidate for the production of natural medicinal compounds capable of preventing and treating a number of chronic and infectious diseases. Additionally, the multifunctional nature of *F. racemosa* makes it an ideal candidate for medicinal use.

Further studies should concentrate on performing clinical trials that will determine the safety, effectiveness, and dosages of formulations containing *F. racemosa*. There is also a need for isolation and characterization of specific bioactive molecules that are involved in various pharmacological actions. In addition, there is a need for mechanistic studies that can explain how this plant exerts its therapeutic properties at a molecular level. These studies can provide useful information that will help develop new drug formulations and herbal preparations using *F. racemosa*.

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