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FICUS BENJAMINA: PHYTOCHEMICAL AND PHARMACOGNOSTIC PERSPECTIVE

Puneet Kaur [1, 2], Rajiv Sharma [* 1] and Supriya Agnihotri [2]

University Institute of Pharma Sciences [1], Chandigarh University Gharuan-Mohali - 160101, Punjab, India. Chandigarh College of Pharmacy [2], Chandigarh Group of Colleges, Landran, Mohali- Punjab- 140307, Chandigarh, India.

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Correspondence to Author:
Dr. Rajiv Sharma

Associate Professor,
University Institute of Pharma Sciences, Chandigarh University Gharuan-Mohali - 160101, Punjab, India.

E-mail: drrajeev.rs@gmail.com

ABSTRACT: In the present study, phytochemical and pharmacological properties of species of *F. benjamina* have been discussed. The phytochemical and pharmacological properties correlate with various active constituents of the plant. *Ficus* belongs to the Moraceae family, found in Asia and Australia, and widely distributed in tropical and subtropical areas, including more than 800 species. The genus *Ficus* constitutes a major tree group with numerous chemical constituents of promising medicinal value. Morphological characteristics of the plant show that it is a fast-growing plant and moderate to high-temperature conditions are more favorable for the fast growth of the plant. A microscopical study has shown the existence of various cells. Different plant parts have been extracted using different solvents and many bioactive compounds, chiefly stigmasterol, quercetin, cinnamic acid, lactose, naringenin, caffeic acid extracted, and isolated from roots, fruits, leaves and barks. *Ficus benjamina* is used by distinct native population groups in many ways as its bark, leaves, roots, fruits, and stem shows various therapeutic uses. Additionally, the stem and bark latex also shows a self-healing process. The plant parts are effective in the treatment of various microbial diseases and viral infections. *F. benjamina* also exhibits antioxidant, antiplasmodial, antitumour, antiulcer, hepatoprotective, antianthelminitic properties.

INTRODUCTION: The genus *Ficus* is a huge group containing more than 800 species and belongs to the Moraceae family. This family contains trees, lianas, shrubs or rarely herbs. Plant species of this genus are distributed in many regions of Southeast Asia, Australia, Malaysia and parts of the pacific regions. It is a holy tree of Hindus and Buddhists.

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The uncertainty in the number of spices within the genus is largely attributed to the great variability among the constituents. Members of this genus are laborious to differentiate by their flowers; still, these can be distinguished by their pattern. The genus *Ficus* constitutes a major group of trees with numerous chemical constituents of promising medicinal value [1, 2].

Ficus is one of the largest genus among angiosperms. It is ranked twenty-first among the genera of seed plants. Carolus Linnaeus published the genus *Ficus* L. (Moraceae) in Systema Naturae in 1735 for the first time [3]. *Ficus* is collectively known as fig trees. The most well-known species in

the genus is the common fig, which produces commercial fruit called fig [4]. *Ficus benjamina* L. is an annual tree that belongs to the family mulberry (Moraceae), which usually grows in tropical and subtropical regions. For thousands of years, it has been used as an ornamental plant that grows up to 30 meters in mild temperatures due to its higher growth, and it is tolerable to low and high-temperature conditions [5]. *Ficus benjamina* cross-pollinates easily, and the resulting diversity and variation have been found. For pollination, wasps play an important role in this species's reproduction. *Ficus benjamina* is the most diverse species within the range. Large numbers of cultivars are available, but the exact numbers are not known while they also vary in flavors and uses [2].

Ficus benjamina is the most commonly known indoor plant in temperate areas as it can tolerate poor growing conditions. It can tolerate considerable shade but can grow best in bright, sunny conditions. In summers, the plant needs adequate watering; during winters, a sufficient amount is required to keep it from drying out. The plant is sensitive to cold conditions and should be protected from strong drafts. Moderate to high day temperatures are favorable conditions for appreciable growth in a short time. When grown in door, it has been shown to be effective in removing gaseous formaldehyde from indoor air [6].

Taxonomical Classification of *Ficus benjamina* [4]

Kingdom	Plantae
Class	Mangoliopsida
Phylum	Tracheophyta
Order	Rrosales
Family	Moraceae
Genus	*Ficus*
Species	*benjamina*

Botanical Description: *Ficus benjamina* is a famous, widespread, non-flowering green plant. *Ficus benjamina* is a developing tree in distinct parts of the world, including America, Australia, Asia, and some European countries [7]. *Ficus benjamina* is known by various names based upon the region like in Tamil - Nintamaravakai, Vellal, Marathi - Nandaruk, Nandarukh, Telugu - Konda Golugu, Konda Zuvvi, Pedda Zuvvi, Putra Zuvvi, Malayalam - Putra Juvi, and Sanskrit - Banij, Mandara and it is known by various names depending upon the geographical distribution as given below [2]:

English Names: Benjamin tree, oval leaf fig, weeping fig.

Common Vernacular Names: 'balete' or 'salisi'

Indian: Pukar

Chinese: 'Chuiye rong' or 'Cong Mao Chui ye rong'

Brazil: Beringan, Figueira benjamina

Germany: 'Benjamin Feige'

Indonesia: 'beringin', 'wariengin'

Israel: 'Ficus ha'shderot'

Myanmar: 'Nyaung thabye'

Netherlands: 'Baniaanboom

Thailand: 'sai yoi bai laem'

Geographical Characters: *F. benjamina* is indigenous to a huge area that includes India, Malaysia, northern Australia, Southeast Asia, southern China, the Philippines, and the islands of the South Pacific. *F. benjamina* is cultivated in many parts of the world. It is described as a native to the northern region of Australia and is also reported as a weed to Western Australia. Some of the areas where *F. benjamina* is found, include Marshall Islands (Kwajalein (cult.), Lifuka/Foa, French Polynesia (cult.), American Samoa (Tutuila), Majuro (cult.), Tonga (Tongatapu, 'Eua, Vava'u, Ha'ano, 'Uiha and probably on most islands), as well as Florida, in the United States [8].

Ficus benjamina is an enormous, spreading, strangulation tree of Asian source, which is known to be naturalized in the past and its local range in spots including the Galapagos Islands, Australia, and the USA, Bangkok, and Thailand. At world circulation, it is found in various nations, for example, in India, Asia: Bhutan, China, Cambodia, Malaysia, Laos, Myanmar, Nepal, Papua New Guinea, Philippines, Thailand, Vietnam; Oceanic Islands: Solomon Islands; Australasia. Furthermore, nearby distribution is found in Andhra Pradesh, Andaman and Nicobar Islands, Assam, Bihar, Delhi, Kerala, Karnataka, Madhya

Pradesh, Maharashtra, Meghalaya, Tamil Nadu, and Tripura. The total figure for weeping fig generation is hard to get [2].

Pharmacognostical Characteristics:

Morphology: Morphological characterization of *Ficus benjamina* tree **Fig. 1A-D** describes a fast-growing tree, up to 30 meters in height, strangler with multiple aerial roots, and stem with drooping foliage, multiple-stemmed, spread, white latex, and strongest root system. The long branches are generally clothed with the alternate, thick, simple, shiny, whole, elliptic, two to five-inch-long, evergreen leaves. A canopy formed by branches weeping towards the ground is so condensed that nothing grows beneath them. The unisexual, auxiliary, monoecious flowers are borne in the fig body. It is one of the most common houseplants [4]. Shiny oval leaves can be grouped into different classes depending on the species, like creamy yellow, and plain green, which can be noticeable with burgundy, green, yellow or pink, and silver-white patterns. *F. benjamina* is available as a natural looking bush; even it also grows on trunks that can be straight, wrapped, or interwoven. Generally, branches droop slightly by, providing it a graceful green appearance.

Leaves are oblong-ovate, leathery, 6-9 cm long, and have a rounded base and a noticeable, slender point. Petioles are 5-10 mm long, while the fruit is solitary, axillary, dark-purple, stalkless, and flesh when mature, rather spherical, and 1 cm in diameter [2].

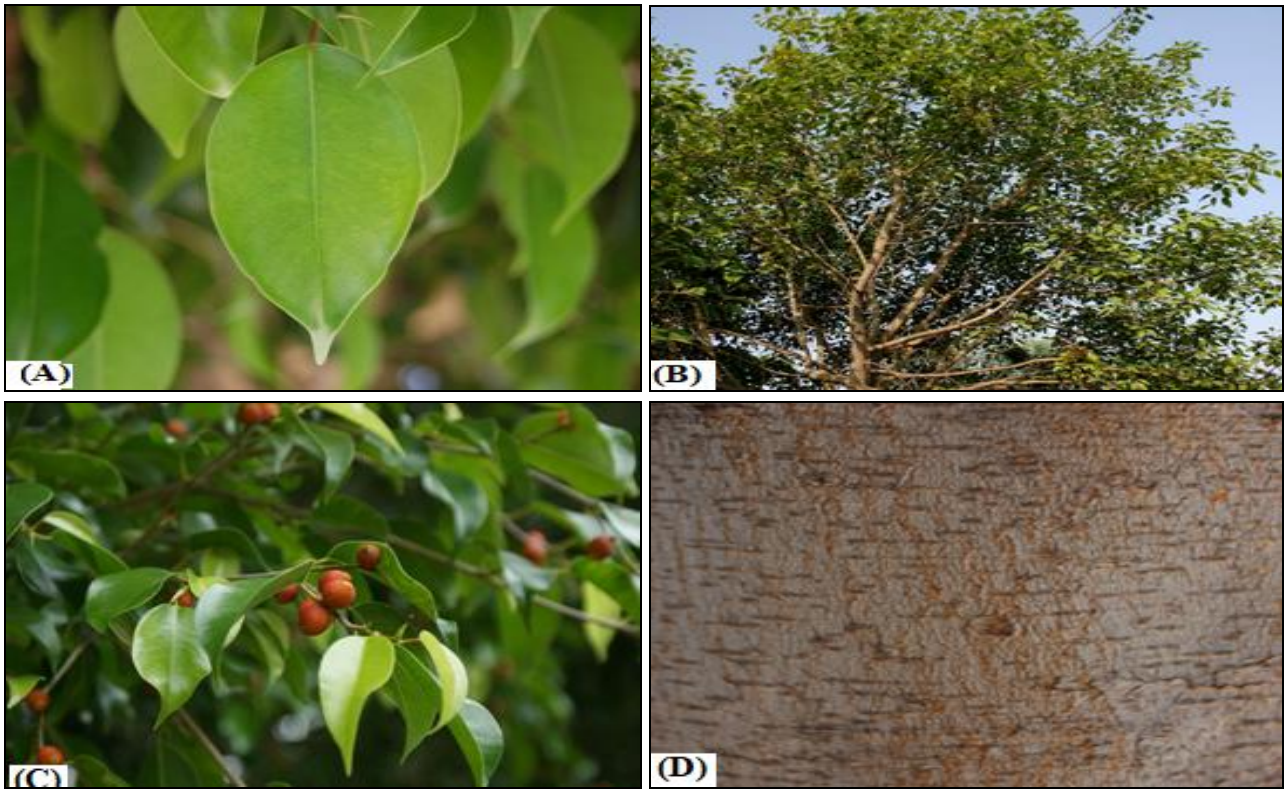

FIG. 1: *FICUS BENJAMINA* (A) LEAVES; (B) TREE; (C) FRUITS; (D) STEM BARK

Microscopy of Leaves of *Ficus benjamina*: Complete TS of *Ficus benjamina* leaf which passes through midrib shows a layer of upper and lower epidermis which is enfolded with cuticle and immersed with paracytic stomata, beneath, both the epidermis of midrib lie 2–3 layers of lignified collenchymas tissue; the leftover tissue being parenchymatous immersed with meristele which consists of 18–20 rows of radially organized 2–3 xylem vessels which become small in size gradually. The transverse section of *Ficus benjamina* shows passing through midrib, which is dorsiventral, rose on the foot side, a bit elevated at the upper side, and appears as an arc of centrally located broad meristele [9]. TS of aerial roots Primary and secondary phloem has been done, and primary phloem shows parenchymatous cells, followed by xylem vessels and xylem parenchyma [4].

Ethnomedicinal Uses: *Ficus benjamina* is used by distinct native population groups in many ways as its bark, leaves, roots, fruits, and stem shows various therapeutic uses **Table 1.**

TABLE 1: ETHNOMEDICINAL USES OF *FICUS BENJAMINA* [10-26]

Part of Plant Used	Usage	Region/tribe
Whole plant	Blood purification	Jalalpur Jattan, District Gujrat
Roots	Fever, headache, asthma, diabetes, postpartum care and recovery	Esperanza, Philippines
Leaves	Antimycobacterial	Bengaluru
Leaves and shoots	Ulcer, cough, dysentery	Northeast India
Bark	For rheumatism	Northern Surigao del Sur, Philippines
Whole plant	Stomachache, blood purification, ulcers	Pakistan
Fruits	Antioxidant	South china
Fruit	Liver diseases	Van Kieu, Vietnam
Fruit, bark, root and leaves	Inflammation, Skin disorders, demulcent, piles, vomiting, leprosy	Tamil Nadu
Leaf, stem, roots	Skin disease, Swelling	Indonesia
Whole plant	Ulcers and leprosy	Western Ghats, Tamil Nadu
Leaves, milky juice	Ulcers, complaints of cornea	West Bengal
Whole plant	Ulcers, leprosy	Western Ghats, Tamil Nadu
Fruit, Stem Bark,	Inflammation, piles, malaria, controls sugar levels,	Chhattisgarh, India
Heartwood, leaves	Boils, cuts, and wounds	Ramechhap District of Nepal

Apart from these ethnomedicinal uses, leaves were considered an important ingredient in the different events of the Hindu religion. Heartwood was used as Timber [26]. Stem and bark latex of *Ficus benjamina* shows an increase in tensile strength after injury, which indicates a considerable contribution to the self-healing process [27]. It is also used as ceremonial and fodder.

Twigs of the plant are utilized as an insect repellant by keeping these beneath the beds. Leaf juice is effectively used as flea and bug repellant [28].

Physiological and Nutritional Analysis: Various physiochemical and nutritional parameters of *Ficus benjamina* has been studied, as shown in **Tables 2** and **3**.

TABLE 2: PHYSIOCHEMICAL PARAMETERS OF DIFFERENT PARTS OF *FICUS BENJAMINA* [9, 5, 29]

Parameter	Stem	Leaves (%w/w)	Root powder
Total ash		11.7±0.18	7.25
Acid-insoluble ash		1.8±0.22	5.80
Water-soluble ash		2.3±0.08	
Moisture content		11.5±0.21	
Alcohol-soluble extractive value		6.72±0.12	8.2
Water-soluble extractive value 1		14.20±0.08	4.8
Total phenolic contents (GAE mg/100 g)	531.76 ± 4.90e	573.06 ± 2.74d	539.17 ± 3.21e
Total flavonoid contents (CE mg/100 g)	1592.20 ± 8.93c	1654.00 ± 8.93b	724.60 ± 0.89f

TABLE 3: MINERAL ANALYSIS OF FICUS BENJAMINA IN LEAVES [30]

Mineral (mg/g)	Leaves
Sodium	5.88
Potassium	11.49
Zinc	1.99
Iron	1.58
Chromium	5.03
Cobalt	0.031
Copper	0.13
Nickel	0.001
Lead	0.04
Manganese	0.132
Calcium	13.94
Magnesium	7.104
Cadmium	0.003

Phytochemistry: The chemistry that deals with plants' chemistry and chemical constituents are known as Phytochemistry. The chemical constituents found in these plants may be active or inactive.

The active constituents include secondary metabolites, like alkaloids, volatile oils, glycosides, tannins etc., whereas inactive constituents are structural constituents of the plants like starch, sugars, or proteins. The active components may be single or mixtures of several substances [31].

Phytochemical screening have been performed on various parts of *Ficus benjamina,* which reveals the presence of anthocyanins, alkaloids, coumarins, carotenoids, flavonoids, glycosides, phenolics, polyphenols, saponins, tannins, triterpenoids volatile components, and vitamins [32].

The presence of those phytoconstituents has revealed a broad variation of biological actions. The presence of the phytoconstituents has been done by various chromatographic techniques, including HPTLC [9] and GC-MS analysis.

GC- MS analysis has been utilized to identify various types of alkaloids present in the leaves and bark extracts, including Isoquinoline type, Indole-type, Steroidal-type, Indolyzidine-type, Quinolizidine-type, Pyridine-type, Carbazol-type, Pyrrolizidine-type, Quinoline-type, Pyrrolidine-type, Tropane-type, and Acridine-type [33]. Leaves of *Ficus benjamina* contain naringenin, cinnamic acid, and quercetin lactose. It has also been reported to have flavonoids, including kaempherol 3-O-rutinoside, quercetin 3-O-rutinoside, and 3-O-kaempherol robinobioside [34-35]. Volatile constituents along with numerous oxygenated volatile organic compounds, such as aldehydes (formaldehyde, acetaldehyde and hexanal) alcohols (menthol, butan-1-ol, pentan-1-ol, pent-4-en-2-ol, pent-2-en-1-ol, and linalool) and organic acids (acetic acids and formic) were identified in leaves [36].

Leaves also show presence of flavone glycosides like quercetin 3-O-rutinoside, kaempferol 3-O-rutinoside, and kaempferol 3-Orobinobioside. Fruit contains alkaloids, anthraquinone glycoside, caffeic acid, cinnamic acid, flavonoids, lactose, naringenin, phenol glycosides, quercetin, stigmasterol, saponin and tannins [37].

Benjaminamide is a new ceramide that was identified from the twigs of *Ficus Benjamin* [35]. The bark of *Ficus benjamina* is found to have various alkaloids, including p-bromo atropine, crinamidine, solasodine, ibogamine, lutidine, cinchophen, and ajamalicine [38].

The identification of phytoconstituents can also be done by making different extracts of the different parts of the plant **Table 1**. The various active constituents are identified, which belong to another class of compounds **Fig. 1**.

Some of these are summarized as follows. The chemical structures of some major bioactive phytoconstituents found in *Ficus benjamina* plant are shown in **Fig. 2**.

TABLE 4: MAJOR COMPOUNDS FOUND IN PLANT PARTS OF *FICUS BENJAMINA* [33, 31,29, 35, 39, 40, 41, 36, 42, 43, 9, 44,45, 34]

S. no.	Plant Part	Extract used	Nature of constituents	Chemical constituents
1.	Roots	Methanol	Phenolic Compounds	p- coumaric, Chlorogenic, ferulic, syringic acids
2.	Leaves	Petroleum ether, ethanol	Flavonoids, alkaloids, glycosides	-
3.	Fruits	Ethyl acetate	Isoflavonoids	Ficusin, gancanonin N, versulin, carpachromene, atalantoflavone
4.	Leaves	Ethanol	Flavonoid glycosides	kaempferol 3-O-rutinoside, kaempferol
5.	Leaves	Methanol	Phenolic compounds	Flavonoids, phenolic acids, tannins
6.	Leaves	Chloroform	Terpenes	Tripene, β- amyrin
7.	Leaves	Ethanolic	Phenols, flavonoids	-
8.	Leaves	Chloroform	Phenolic acid, Carbohydrates	Cinnamic acid, lactose
		n- butanol	Flavonone, flavonols, phenolic acids	Naringenin, quercetin, caffeic acid
	Bark	Chloroform	Sterol	Stigmasterol
9.	Leaves	Water, ethanolic, ethyl acetate, n-hexane	Polyphenols, quinines	-
10.	Leaves	Petroleum ether	Glycosides, phytosterols, steroids, phenols	-
11.	Root Bark	Aqueous methanol	Triterpene and ceramide	Platanic acid, benjaminamide

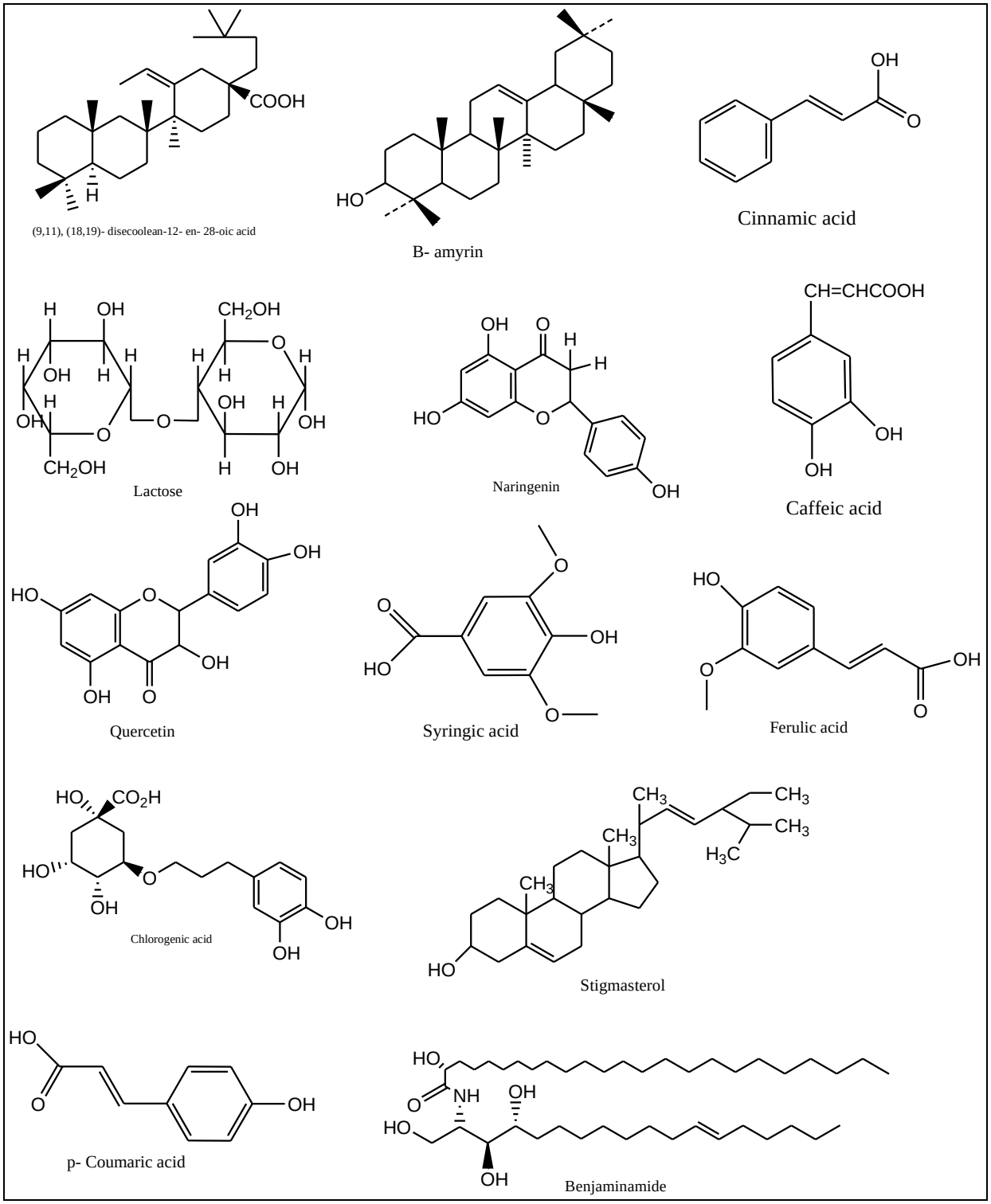

FIG. 2: STRUCTURES OF MAJOR PHYTOCHEMICALS PRESENT IN DIFFERENT PLANT PARTS

Pharmacological Profile: Different extracts of *Ficus benjamina* possess a broad spectrum of pharmacological activities. The plant contains various medicinally potent substances like sugars, flavonoids, phenols, enzymes, and vitamins A, C, and K. The leaves, fruits, and bark of the plant contain stigmasterol, lactose, quercetin, cinnamic, and caffeic acid.

The extracts of leaves have shown antiviral against Virus Herpes simplex 1 and 2, antioxidant, antibacterial, antinociceptive, and analgesic activities. Various flavonoids have been identified in the plant, which play an important role in fighting against several viruses [42]. The different *in-vitro* and *in-vivo* activities of the plant are given in **Table 5.**

TABLE 5: PHARMACOLOGICAL EFFECTS OF *FICUS BENJAMINA* [41, 45, 46, 47, 48, 37, 49, 50, 51, 52, 53, 54, 55, 56, 57, 58, 59]

Plant Part used	Extract/ Fraction	Animals/cell lines	Experimental models	Result
Leaves	Chloroform	*E. Coli*	Agar well diffusion method	Antimicrobial activity
Fruits	Chloroform	*Micrococcus luteus*	Filter paper disc diffusion method	Antibacterial activity
Leaves	Ethanolic	*Citrobacter freundii*	Muller-Hinton agar disc diffusion method	Antibacterial potential
Leaves	Methanolic	*Pseudomonas aeruginosa*	Disc diffusion method	Antimicrobial activity
Leaves	Aqueous, methanol	*Clostridium perfringens*	Agar disc diffusion method	Antibacterial activity
Leaves and stalks	Ethanolic	*Staphylococcus aureus* and *Escherichia coli*.	Macro dilution method	Antibacterial activity
Leaves	Ethanolic	Wistar Albino Rats	------	Hepatoprotective
Leaves	Aqueous	male Balb/c mice	------	Hepatoprotective effect
Stem	Ethanolic	HepG2 cells	t-BHP-induced hepatotoxicity	Shows protective effect
Leaves, bark	Ethanol , Methanol	*In-vitro*	DPPH and ABTS	
Leaves, stem	Aqueous, methanol, acetone	----------	DPPH assay method	showed maximum inhibition
Leaves	Pet. Ether	*P. falciparum*	Schizont maturation inhibition assay	Antiplasmodial activity
Leaves	Ethyl acetate	*Mycobacterium smegmatis*	Broth micro dilution method	Antimycobaterial activity
Figs	Methanol and aqueous	*Pheretima posthuma*	*In-vitro*	Anti-helmintic activity
Leaves	Ethanolic	NDV Lasota	Embryonated chicken egg model	Anti viral activity
Stem, leaves	Ethanolic	HSV-1, ATCC (VR-735),	cytopathic effect	Anti viral activity
Leaf	Ethanolic	Alphaglucosidase and α-amylase enzymes	----------	Antidiabetic effect
Leaves, stem	Aqueous, methanol, acetone	Red blood cell (RBC) suspension	Measurement of percent inhibition of plant extract	Maximum inhibition activity

CONCLUSION: *Ficus benjamina* has been used for its various potentials, from the old-fashioned Ayurveda arrangement of solution. It can be seen in this review that *Ficus benjamina* contains various phytochemicals, which are responsible for the therapeutic estimate of this plant. *Ficus benjamina* is proved responsible for several pharmacological impacts in the treatment of different diseases, including diabetes, antihelmintic activity, antimycobacterial and antioxidant. *Ficus benjamina* is rich in various minerals, yet there is a need to investigate its other potentials. Many analyses have shown the presence of active constituents responsible for various effects; still, the plant and its parts can be explored for other properties.

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