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PHYTOPHARMACOLOGY AND PHARMACOGNOSTIC PROPERTIES OF *FICUS BENGHALENSIS* - A REVIEW

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ABSTRACT: Since, ancient time, plants have been an exemplary source of medicine. Ayurveda and other Indian literature mention the use of plants in the treatment of various human ailments. *Ficus benghalensis* Linn is a large evergreen tree found throughout forest tracts of India. It is a popular indigenous system of medicine like Ayurveda, Siddha, Unani and Homeopathy. In the traditional system of medicine, various plants part such as stem bark, root bark aerial roots, vegetative bubs, leaves, fruits, and latex are used in dysentery, diarrhea, diabetes leucorrhoea, menorrhagia, nervous disorders, tonic and astringent. According to the ayurvedic system of medicine, *Ficus benghalensis* Linn. (Banyan tree) is well known to be useful in diabetes. The present review is, therefore, an effort to give a detailed survey of the literature on its pharmacognosy, phytochemistry, traditional and pharmacological uses.

INTRODUCTION: Plants have been the primary source of drugs in medicine and another ancient system in the world. Herbalism is a traditional medicine or folk medicine practice based on the use of plant extracts [1]. Charaka Samhita and Sushrusha Samhita give an extensive description of various medicinal herbs. The genus Ficus includes some 750 species of plants occurring in most tropical and subtropical forests throughout the world. The genus is remarkable for the large in the habits of its species [2]. Many plants of this genus are used in medicine for the treatment of skin diseases, enlargement of liver and spleen, dysentery, diarrhea, diabetes, leprosy, lung complaints, leucorrhoea, heart diseases, cough, asthma, pills, ulcers, gonorrhea and rheumatism [3, 4].

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Several species belonging to the genera of ficus were reported to contain furanocoumarins which are important plants phototoxins [5, 6]. *Ficus benghalensis* is commonly known as a Banyan tree. This tree is considered to be a sacred tree in India. The plant is a large evergreen tree distributed all over India from the sub-Himalayan region and in the deciduous forest of Deccan and south India. It is a grown in gardens and roadsides for shades [7, 8]. The bark, leaves, and fruits of this group are used as an astringent, hemostatic, antiseptic, anti-inflammatory, antioxidant and anticancer agent and also in the treatment of diarrhea, dysentery, and in the treatment of skin diseases, ulcer, vaginal disorders, leucorrhoea, menorrhagia, and deficient lactation. In the traditional system of medicine, the plant is used for various health problems and diseases [9-13]. This study was aimed to present on overview of traditional, phytopharmacology and pharmacognostic investigations of bioactive compounds present in these plants.

Habit and Habitat: *Ficus benghalensis* is a fast-growing, evergreen tree. Found in monsoon and

rain forests; grow up to 3.0 meters, with spreading branches and many aerial roots. Leaves stalked, ovate-cordate, 3-nerved, entire, when young downy on both sides; petiole with a large, smooth greasy gland at the apex, compressed, fuzzy; fruit in axillary pairs, the size of a cherry, round and downy [14, 15, 16].

Scientific Classification of *Ficus*:

Kingdome: Plantae
Phylum: Traceophyta
Class: Magnoliopsida
Order: Urticales
Family: Moraceae
Genus: Ficus
Species: Ficus L.
Synonyms: *Ficus indica* L. & *Ficus banyan*

Pharmacognostical Characteristics:

Macroscopical: The tree, often huge, up to 30 m tall, with many aerial roots which develop into new trunks so that the tree goes on spreading laterally indefinitely [17]. The leaves are leathery, entire, ovate or elliptic, 20-40 cm wide, apex obtuse, base rounded with prominent lateral veins; petioles 2.5-5 cm long; stipules stout different arrangement and has reticular pinnate venation.

The fruits are 1 to 2 cm in diameter, globose, without stalks, in pairs in leaf axils, and when ripe are bright red. The bark is grey, hard surfaced and uneven; 0.5-19 cm thick, on rubbing white papery flakes come out for the outer surface inner surface light brown fracture fibrous taste mucilaginous without any characteristics odor [18].

FIG. 1: FRUITS & LEAVES OF *F. BENGHALENSIS*

FIG. 2: BARK OF *F. BENGHALENSIS*

Microscopical: A transverse section of the bark of *Ficus benghalensis* showed, the peripheral zone viz. the cork tissue was composed of three to six rows of thick-walled rectangular cells nearly twice as long as broad. The cortex was relatively wide and composed of several rows of cells. A wide continuous band of sclereids or polygonal and have thick, pitted walls. In addition to this band of mechanical tissue, the cortex contained several, scattered, one to few-celled groups of stone cells. The cortical parenchyma cells were thin-walled and more or less cubical to oblong.

Several of them are loaded with compound starch grains, while others contain calcium oxalate crystals or tannin. The inner bark was thin and consisted of radial segments of phloem alternating with two to five seriate medullary rays. The wood composed of vessels, wood fibers, and wood parenchyma and medullary ray. The wood parenchyma and medullary ray cells are pitted in the wood region. Vessels occur singly or in groups of two or three [19, 20.]

Physical Constants: The foregin matter about 3, total ash 11.63%w/w, insoluble acid ash 4.5% w/w, alcohol soluble extract 4.8% w/w and water soluble ash 7.56% w/w [21].

Traditional Properties: *Ficus benghalensis* is commonly called nyagrodha. Ancient nighantus and modern pharmacopeias of India medicine contain much valuable information about the pharmacological properties of various parts of

Ficus benghalensis. The tree is regarded everywhere, as a symbol of peace and harmony. It was planted by emperors of the time, Jain, sanaatanists and Buddhist in India and outside, along pilgrimage and trade routes, to serve as sources of the shelter of pilgrims and distance travelers. Banyan tree was providing shade for visitors, cultural activities and community worship.

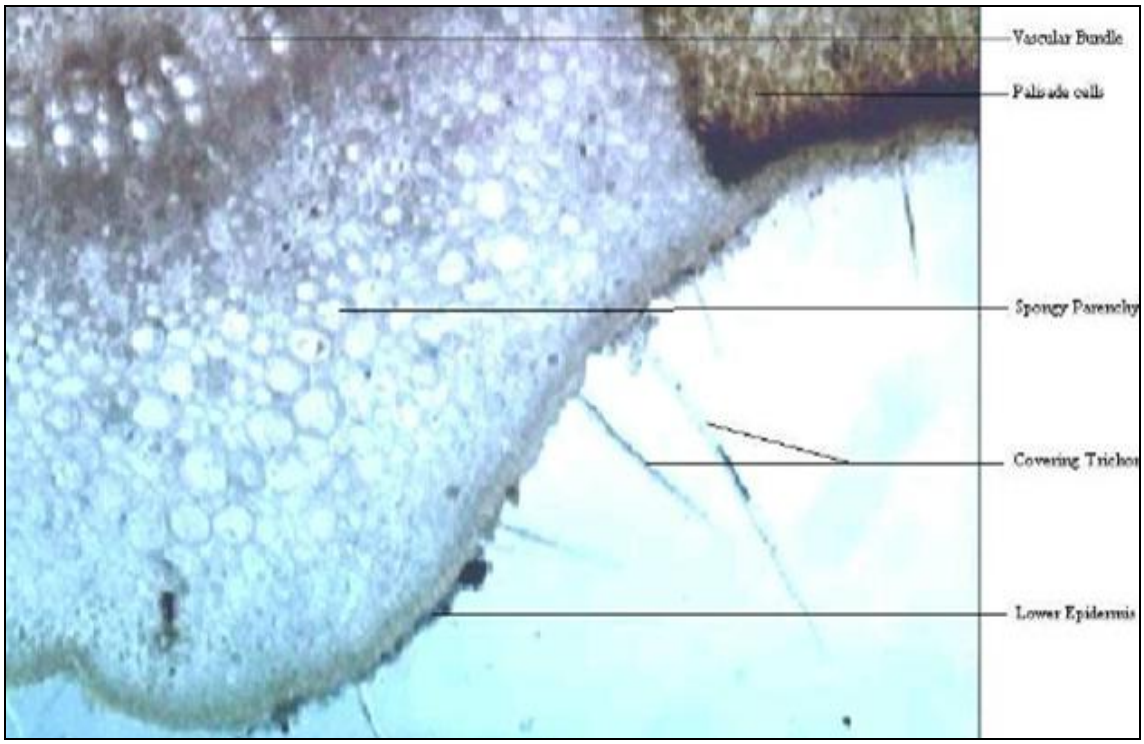

FIG. 3: TRANSVERSE SECTION OF LEAF OF *F. BENGHALENSIS*

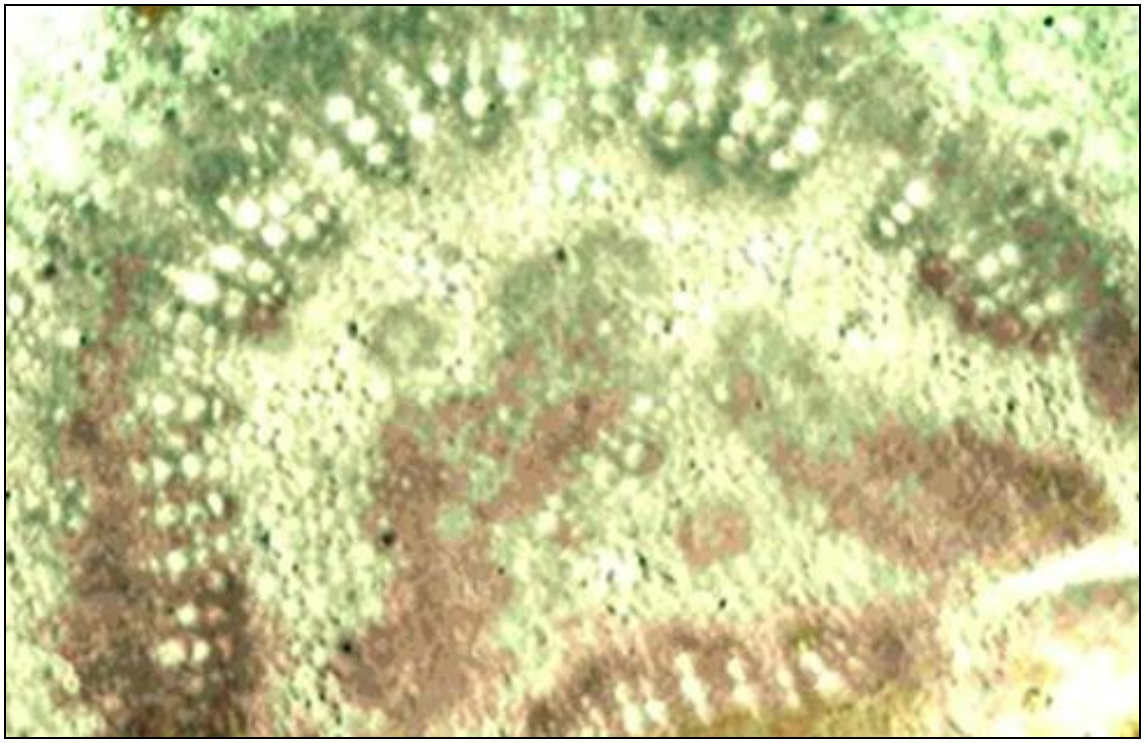

FIG. 4: TRANSVERSE SECTION OF LEAF OF *F. BENGHALENSIS*

Charaka prescribed aqueous extract of life buds of Nyagrodha (*Ficus benghalensis*) mixed with sugar and honey for checking diarrhea; milk processed with the aerial roots or leaf of nyagrodha in hemorrhages and bleeding piles; a decoction of leaf and aerial roots of Nyagrodha, mixed with honey,

was given for checking vomiting and thirst; also during fevers with burning sensation (Ashtanga Hridaya, Vrindamaadhava, Vaidyamanorama) [22].

Root: The root is useful in obstinate vomiting and leucorrhoea and is said to be used in osteomalacia of the limbs.

Bark: The bark is useful in burning sensation, hemoptysis, hemorrhages, diarrhea, dysentery, diabetes, enuresis, ulcers, skin diseases, gonorrhea, leucorrhoea, and hyperpiesia.

Leaves: The leaves are good for ulcers, leprosy, the allergic condition of the skin, burning sensation, and abscesses.

Buds: The buds are useful in diarrhea, and dysentery.

Fruits: The fruits are refrigerant and tonic and are useful in the vitiated condition of pitta.

Latex: The latex is useful in neuralgia, rheumatism and lumbago bruises, mastitis, menorrhagia, ulitis, odontopathy, hemorrhoids, gonorrhea, inflammations, cracks, of the soles and skin diseases [23]. Milky juice and seeds are beneficial as a local application to sores and ulcers, soles of the feet when cracked or inflamed and in rheumatism. Leaves are heated and applied as a poultice to abscesses; tender leaves pasted with honey beneficial in raktapitta. Tender end of the hanging (areal roots) are antiemetic. Seeds are cooling and tonic [24, 25, 26].

Phytochemical Properties of *Ficus Benghalensis*: Preliminary phytochemical investigation of the root of *ficus benghalensis* showed the presence of carbohydrates, flavonoids, amino acids, proteins, saponins, and tannins [27]. Leaves yield contain, rutin, friedelin, taraxosterol, lupeol, β-amyrin along with psoralen, bergapten, β-sisterol and quercetin-3-galactoside [28]. The bark of *Ficus benghalensis* contains leucopelargonidin-3-o-α-L rhamnoside and leucocyanidin 3-o-β-D galactosylcellobioside, glucoside, beta glucoside, 20-tetratriaconthene-2-one, 6-heptatriacontan-10-one, pentatriacontan-5-one, beta sitosterolalpha-D-glucose, and meso-inositol [29, 30]. Leucodelphinidin derivative [31], Bengalenoside: A glucoside [32], Leucopelargonin derivative [33, 34], leucocynidin derivative [35], a glycoside of leucopelargonidin [36], have been isolated from the bark of the *ficus benghalensis*.

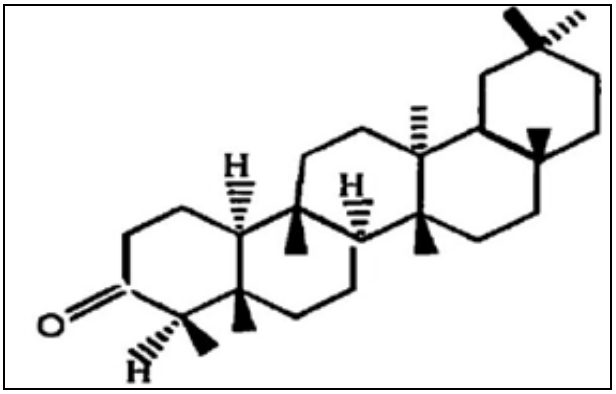

FIG. 5: FRIEDELIN

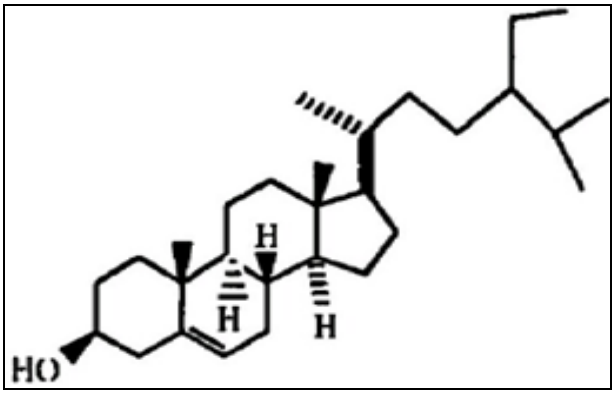

FIG. 6: β SITOSTEROL

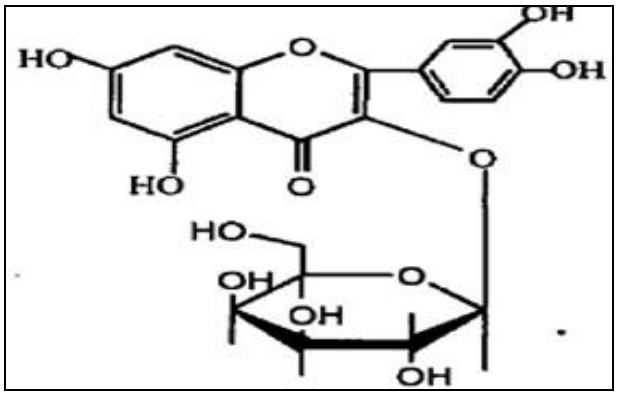

FIG. 7: QUERCETIN-3 GALACTOSIDE

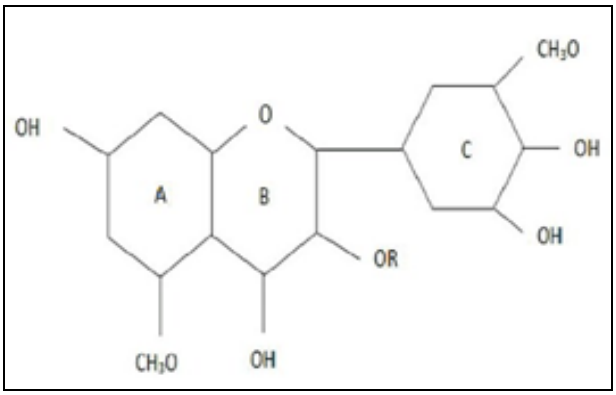

FIG. 8: LEUCODELHENIDINE

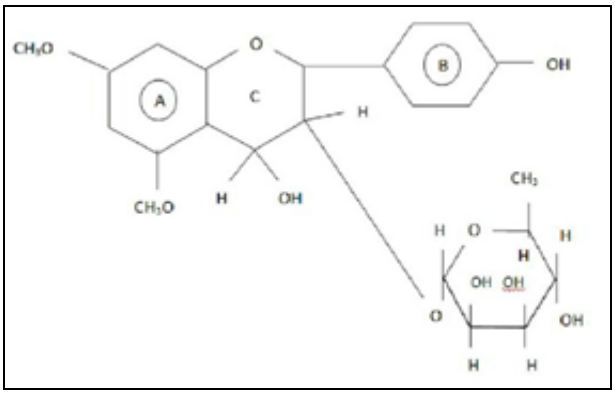

FIG. 9: 5, 7 DIMETHYL ETHER OF LECOPELARGONIDIN, 3-0-α-L RHEMNOSIDE

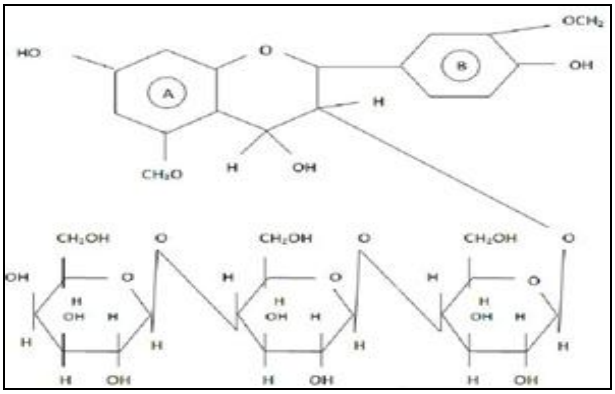

FIG. 10: 5, 7 DIMETHYL LEUCOCYANIDIN, 3-O-β-D GALACTOSYL CELLABIOSIDE

Pharmacological Activities:

Anti-atherogenic: One month treatment of alloxan dogs with glycoside, *viz.* leucopelargonidin derivative (100mg/kg/dy) isolated from the bark of *Ficus benghalensis* decreased fasting blood sugar and glycosylated hemoglobin by 34% and 28% respectively. Body weight was maintained in both the treated groups while the same was decreased significantly by 10% in the control group. In cholesterol diet fed rats, as the atherogenic index and the hepatic bile acid level and the fecal excretion of bile acids and neutral sterols increased, the HMG-COA reductase and lipogenic enzyme activity in heart and adipose tissue and plasma LCAT activity and the incorporation of labeled acetate in to free and ester cholesterol in liver decreased significantly [37].

Antitumor: Fruit extract exhibited anti-tumor activity in the potato disc bioassay. None of the tested extracts showed any marked inhibition on the uptake of calcium into rat pituitary cells GH4CL. The extracts of the four tested *Ficus species* had significant antibacterial activity, but no antifungal activity. The results of this preliminary investigation support the traditional use of their plants in folk medicine for respiratory disorders and certain skin diseases [38].

Anthelmintic: The methanolic, chloroform and pet ether extract of the roots of *Ficus benghalensis* have potent anthelmintic activity when compared with conventionally used drug and is equipotent to standard anthelmintic drug [39].

Anti-stress and Anti-allergic: Various extracts of *Ficus benghalensis* bark were screened for its anti-allergic and antistress potential in asthma by milk-induced leucocytosis and milk-induced eosinophilia. Aqueous, ethanol, and ethyl acetate extracts showed a significant decrease in leucocytes and eosinophils in the order given while petroleum ether and chloroform extracts were inactive. This shows the application of polar constituents of *F. benghalensis* bark as anti-stress and ant allergic agents in asthma [40].

Hypoglycemic: According to the ayurvedic system of medicine *Ficus benghalensis* L. (Banyan tree) is well known to be useful in diabetes. This attention of many earlier workers who studied by the hypoglycemic effect of extracts for the bark of *Ficus benghalensis* and tried to isolate active compounds. The bark of this plant has anti-diabetic properties. The hypoglycemic effect of an extract of bark was demonstrated in alloxan diabetic rabbits and humans. Potent hypoglycemic water insoluble principal was isolated from the bark in our lab by Babu *et al.* A water-soluble hypoglycemic principal was also isolated from the bark in our lab by Shukla *et al.*, which was effective at a low dose of 10 mg/kg, b.w./day. Both the banyan bark principals were effective in mild as well severe alloxan-induced diabetes in rabbits, and improved lipid profile. Mechanism of action of water-soluble and insoluble hypoglycemic compounds was investigated [41, 42].

Hypolipidemic: Hypolipidemic effect of the water extract of the bark of *Ficus benghalensis* was investigated in alloxan-induced diabetes mellitus in rabbits showing a good glycemic control also corrects the abnormalities in serum lipid profile associated with diabetes mellitus. Given the ability of the water extract of *Ficus benghalensis* to improve carbohydrate and lipid metabolism [43]. Dietary fibre content of foods namely, khejri

(*Prsopsis cinceria*), peepalbanti (*Ficus religiosa*), barbanti (*Ficus benghalensis*) gullar (*Ficus glomerata*) and teent (*Capparis decidua*) varied from 38.5%, to 55.7%. Fiber from all there plant foods, fed at the 10% dietary level to rats, induced a greater resistance to hyperlipidemia than cellulose. The dietary fiber influenced total lipids, cholesterol, triglycerides and phospholipids and phospholipids of the liver to varying extents [44].

Immunomodulatory: To evaluate the immuno-modulatory activity of the aerial roots of *Ficus benghalensis* (family Moraceae). The successive methanol and water extracts exhibited a significant increase in the percentage phagocytosis versus the control. In the *in-vivo* studies, the successive methanol extract was found to exhibit a dose-related increase in the hypersensitivity reaction, to the SRBC antigen, at the concentrations of 100 and 200 mg/kg. It the antibody titer value, to SRBC, at doses of 100 and 200 mg/kg in animal studies [45].

Wound Healing: Some of these plants have been screened scientifically for the evaluation of their wound healing activity in different pharma-cological models and patients, but the potential of most remains unexplored. In a few cases, active chemicals constituents were identified. Some Ayurvedic medicinal plants, namely *Ficus benghalensis Cynodon dactylon, Symplocos racemosa, Rubiacordi folia, Pterocarpus santalinus, Ficus racemosa, Glycyrrhiza glabra, Berberis aristata, Curcuma longa, Centella asiatica, Euphorbia nerifolia,* and *Aloe vera*, were found to be effective in experimental models. This paper presents a limited review of plants used in Ayurvedic medicine [46].

Antioxidant and Hypolipidaemic Activity: Their groups of rabbits were fed with cholesterol suspended in groundnut oil to make hyper cholesterol condition (100 mg/kg/day), in addition to this one group is fid with bark extract of *Ficus benghalensis* at a dose of 50 mg/kg/day. Feeding cholesterol increased serum cholesterol, triacylglycerol significantly. Treatment with bark extracts triacylglycerol by 54% and a decrease in lipid peroxidation. Further, there was a significant increase in the activities of antioxidant enzymes; superoxide dismutase, catalase, glutathione peroxidase, and glutathione reductase; which were depressed in other groups after cholesterol feeding. This result show that the water extract of the bark of *Ficus benghalensis* has a significant antioxidant effect, in addition to hypolipidaemic effect [47].

Antioxidant Activity: The extract was investigated for its antioxidant activity by 1,1-diphenyl, 2-picryl hydroxyl (DPPH) radical scavenging activity, hydroxyl radical scavenging activity, reducing capacity, hydrogen peroxide activity, total phenolic content using Folin-Ciocalteu's phenolic reagent. The extract showed maximum scavenging of DPPH radical (96.07%) at 250µg ml^{-1}concentration and hydrogen peroxide (69.23) at 1000 µg ml^{-1} concentration. The extract shows good results when compared with other compounds. This shows the scavenging activity of the extract [48].

Demonstrated that the methanolic extract of *Ficus benghalensis* protects against isoniazid and rifampicin-induced oxidative liver injury in rats as evidenced by significant reduction of isoniazid-rifampicin-induced elevation in the levels of serum diagnostic liver marker enzymes (SGPT, SGOT, and ALP) and Thio-Barbituric acid reactive substance (TBARS) level. Moreover. Total protein and reduced glutathione levels were significantly ($P<0.001$) increased in treatment group [49].

Anti-inflammatory and Analgesic Activity: Treatment with methanol extract during inflammatory condition both acute (carrageenan-induced hind paw edema and acetic acid induced vascular permeability) and subchronic (cotton pellet induced granuloma) prevented an increase in malondialdehyde formation and myeloperoxidase activity in edematous as well as granulomatous tissue. Further serum marker enzymes (AST, ALT, and ALP) increased in inflammatory conditions was also inhibited with methanol extract treatment. Also the extract also showed significant analgesic activity in acetic acid-induced writhing [50].

Anti-inflammatory Activity: To determine the anti-inflammatory effect of methanolic extracts of the leaves of *Ficus benghalensis* which was evaluated in experimental animals indicated that the methanolic extract of *Ficus benghalensis* exhibited significant activity in the treatment of inflammation compared with the standard drug diclofenac, in formalin-induced hind paw edema

model in rats as measured using plethysmometrically [51]. In trinitrobenzene sulfonic acid (TNBS) induced inflammatory bowel disease (IBD) another inflammatory disease model in rats, aqueous extract of *Ficus benghalensis* bark exhibited a significant protective effect on the colonic tissue malondialdehyde (MDA), myeloperoxidase (MPO), superoxide dismutase (SOD), and nitric oxide (NO), levels and presence mast cell protection in mesentery as compared to prednisolone in rats [52].

The ethanolic (300 mg) and petroleum ether extract (600 mg/kg/day) of *F. benghalensis*, significantly reduced ($P<0.05$) carrageenan-induced paw edema in rats. The ethanolic and petroleum ether extracts showed a greater anti-inflammatory compared with the standard drug indomethacin. The results indicated the ethanolic extract of *Ficus benghalensis* exhibited more significant activity than petroleum ether in the treatment of inflammation [53].

Anticancer and Antibacterial Activity: Fruits extract exhibited antitumor activity in the potato disc bioassay. None of the tested extracts showed any marked inhibition on the uptake calcium into rat pituitary cells GH_4C_1. The extracts of the four tested *Ficus species* had significant antibacterial activity, but no antifungal activity, the result of this preliminary investigation support the traditional use of their plants in folk medicine [54].

Antibacterial Activity: Extract from fruits exhibits antitumor activity in the potato disc bioassay. None of the tested extracts showed any marked inhibition on the uptake of calcium into rat pituitary cells GH_4C_1. The extracts of the four tested *Ficus species* had significant antibacterial activity [55].

Anti-diabetic and Ameliorative: The aqueous extract of *Ficus benghalensis* at a dose of 500 mg/kg/day exhibits significant anti-diabetic and ameliorative activity as evidenced by histological studies in normal, and *Ficus benghalensis* treated streptozotocin induced diabetic rats. By our findings, it could be used as an anti-diabetic and ameliorative agent for better management of diabetes mellitus [56].

Analgesic and Antipyretic Activity: The antipyretic activity of bark of *Ficus benghalensis* was studied in Brewer's yeast-induced pyrexia in rats. The extract at all the doses used and the Aspirin significantly inhibited both the analgesic activity for the hot plate and tail immersion method also in the antipyretic activity for the method or Brewer's yeast-induced pyrexia in rats inflammation in a manner that was not dosed dependent. The higher analgesic effects of various extracts tested might back to the presence of flavonoids and phenolic compounds. These data suggest that the different extracts of the bark of *Ficus benghalensis* produce analgesic and antipyretic activities that could be due to the effects of bioactive components in the extract [57].

Analgesic Activity: The analgesic activity of stem bark extraction of *Ficus benghalensis* tested using acetic acid-induced writhing model on rats, showed significant analgesic activity [58].

Anti-diarrhoeal and Anthelmintic Activity: The ethanol extract of the hanging roots of *Ficus benghalensis*, when administered per orally reduced diarrhea by inhibiting gastrointestinal motility and PGE2-induced entero-pooling against castor oil induced diarrhea [59]. Also the methanolic, aqueous, chloroform and petroleum ether extracts of the roots of *Ficus benghalensis* have potent anthelmintic activity when compared with the conventionally used drug, as they were found not only to paralyze but also to kill the worms [60].

Anti-stress, Anti-allergic and Immuno-modulatory Activity: Various extracts (aqueous, ethanol and ethyl acetate extracts) of *Ficus benghalensis* bark screened for their antiallergic and anti-stress potential in asthma model by milk-induced leucocytosis and milk induced eosinophilia, demonstrated a significant decrease in leucocytes and eosinophils in the order given while petroleum ether and chloroform extracts were inactive. This shows the application of polar constituents of Ficus benghalensis bark as anti-stress and anti-allergic agents in asthma [61].

The Immunomodulatory activity of the aerial roots of *Ficus benghalensis* for its effect on both specific and non-specific immunity and successfully proved that the extract exhibited a significant increase in percentage phagocytosis by human neutrophils in the *in-vitro* tests. In an *in-vivo* study, the extract

was found to exhibit a dose-related increase in the hypersensitivity reaction, to the sheep RBC antigen. It also resulted in a signification increase in the antibody titer value, to sheep RBC [62-65].

CONCLUSION: There are 400 different tribal and other ethnic groups in India which constitute about 7.5% of India' population. Tribal, rural, and primitive societies have discovered a solution for treatment of disease to almost all there need and their problems from the natural resources around them. Hence, in recent years, ethnomedicine studies received much attention as this brings to light the numerous little known and unknown medicine virtues especially of plant origin which need evaluation on modern scientific lines such as phytochemical analysis, pharmacological screening.

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CONFLICT OF INTEREST: Nil

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