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The Healing Potential of Ficus virens: A Pharmacognostical and Phytochemical Perspective on the White Fig

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ABSTRACT

Ficus virens Aiton, widely recognized as the White Fig or Pilkhan, is a versatile arboreal species within the Moraceae family, esteemed in various traditional healing systems including Ayurveda and Siddha. Historically utilized for its therapeutic efficacy, the species has been employed in the management of pathophysiological conditions such as gastrointestinal dysfunctions, respiratory ailments, dermatopathies, and chronic inflammatory disorders. These pharmacological effects are largely attributed to its extensive repertoire of bioactive secondary metabolites, notably flavonoids, triterpenoids, tannins, alkaloids, phenolic acids, and saponins. This review offers a comprehensive, interdisciplinary analysis of F. virens through a pharmacognostical and phytochemical lens, encompassing its macro- and micromorphological traits, anatomical diagnostics, powder microscopy, and organoleptic characteristics. Furthermore, this synthesis critically appraises experimental evidence from in vitro and in vivo models that substantiate its diverse pharmacodynamic actions, including antioxidant, antimicrobial, hepatoprotective, antidiabetic, wound-healing, and neuroprotective activities. The paper also outlines its emerging utility in pharmaceutical formulations, nutraceutical innovations, and cosmeceutical applications. Despite the growing scientific interest, the pharmacological advancement of F. virens is constrained by significant research lacunae—particularly the lack of randomized clinical trials, insufficient mechanistic elucidation, and variability in phytochemical standardization. Future perspectives underscore the necessity of integrating cutting-edge technologies such as metabolomics, high-throughput screening, nanotechnology-based delivery systems, and green extraction protocols. Concurrently, ensuring sustainable harvesting and establishing rigorous quality control standards are essential for its translational success. Overall, Ficus virens emerges as a pharmacobotanical candidate of significant clinical and industrial promise within evidence-based herbal medicine.

Keywords: *Ficus virens, phytochemistry, pilkhan, pakar, antioxidant, Nutraceuticals*

1. INTRODUCTION

Phyto-therapeutics derived from medicinal flora have historically constituted the foundation of traditional healthcare systems, serving as primary sources of bioactive secondary metabolites with multifaceted pharmacological properties[1].Among such botanicals, Ficus virens]Aiton, colloquially referred to as the white fig or pilkhan or pakad, is a prominent member of the Moraceae family with a long-standing ethnopharmacological legacy across the Indian subcontinent and parts of Southeast Asia. This deciduous tree species has been extensively employed in indigenous medical systems for the management of diverse pathological conditions, including but not limited to gastrointestinal disturbances, inflammatory states, cutaneous lesions, and pulmonary disorders. [2]

Although traditional claims underscore its therapeutic utility, the scientific validation and comprehensive pharmacognostical characterization of Ficus virens remain relatively underrepresented in contemporary literature. [3] Recent advancements in natural product research and drug discovery underscore the imperative to investigate such traditionally revered species for their phytoconstituent profiles and potential bioactivities. Preliminary phytochemical investigations of various Ficus species, including F. virens, have revealed the presence of diverse classes of compounds such as flavonoids, polyphenols, alkaloids, saponins, tannins, and triterpenoids—each contributing to the plant's pharmacodynamic potential. [4]

Ficus virens Aiton, a member of the family Moraceae, is a mesophytic to hygrophytic arboreal species exhibiting considerable variability in stature, typically reaching altitudes of 24–27 meters in xeric habitats, and extending up to approximately 32 meters in more pluviose, mesic environments.[5] It is taxonomically classified among the strangler figs, a subgroup of hemiepiphytic Ficus species characterized by allomorphic seed germination on phorophyte hosts, followed by aggressive adventitious root proliferation that ultimately leads to mechanical asphyxiation and senescence of the host organism.[6]

Phenologically, F. virens demonstrates a distinct bimodal vegetative growth pattern within the Indian subcontinent, with pronounced foliar regeneration phases observed during the pre-monsoonal vernal period (February to early May) and the monsoonal season (June to early September). The emergence of juvenile foliage is marked by a striking reddish-pink pigmentation, attributable to anthocyanin accumulation, contributing to the plant's visual and ornamental prominence. [7]

Structurally, the species exhibits a broad, often disproportionately expansive crown architecture, frequently exceeding the tree's vertical height. A notable specimen documented by Campbell (citation needed) displayed an extraordinary basal girth measuring approximately 37 meters at breast height—equivalent to a diameter at breast height (DBH) of 11.5 meters—without observable buttressing or basal hypertrophy, indicating a remarkably cylindrical bole morphology for a tree of such magnitude. [8]

This review endeavors to systematically elucidate the pharmacognostical attributes and phytochemical constituents of Ficus virens, thereby providing a consolidated scientific foundation for its medicinal potential. [9] By integrating traditional ethnobotanical knowledge with modern phytochemical and pharmacognostic methodologies, this work aims to reinforce the therapeutic relevance of F. virens within the broader context of evidence-based herbal medicine and rational phytopharmaceutical development. [10]

Despite the abundance of ethnopharmacological data and the escalating scientific interest surrounding the Ficus genus, a systematic and integrative assessment of the antioxidant properties and therapeutic utilities of its various species remains conspicuously absent in current literature. Such an evaluation is imperative for the strategic identification of species with the highest pharmacological potential, facilitating their targeted application in specific clinical contexts. Moreover, a thorough comparative analysis of the antioxidant efficacy across different Ficus taxa could significantly inform future advancements in the domains of phytopharmaceuticals, functional nutraceuticals, and health-promoting food products. This is particularly relevant given the growing global shift toward naturally derived antioxidants, which are increasingly favored over synthetic analogs due to their reduced toxicity and minimal adverse effects. Consequently, the present review endeavors to deliver a critical and comparative exploration of the antioxidant capacity and pharmacodynamic relevance of medicinally valuable Ficus species, thereby laying the groundwork for future translational research and therapeutic exploitation. [7,8]

Taxonomical classification of plant:

Ficus virens is a rapidly growing, deciduous to semi-evergreen species demonstrating an early-stage hemiepiphytic developmental strategy, predominantly observed within forest ecosystems. During its initial phase, the species germinates as an epiphyte on the surface of host trees. [9]

As development progresses, it produces adventitious aerial roots, which elongate downward to establish contact with the soil, ultimately facilitating its transformation into a self-sustaining, erect arborescent form. This strangulating growth pattern is a hallmark trait of taxa within the Ficus genus.

Plant Name: Ficus virens [1]

Synonyms: Ficus infectoria Roxb. (frequently used in older literature), Ficus virens var. sublanceolata. [5]

Common Names: White Fig, Pilkhan / Pakar (Hindi), Gandha-vata (Sanskrit), Juvvi (Telgu), Alinjil (Tamil), Basari (Kannada), Alinjil (Malyalam). [29]

Taxonomy of plant: **[18]**

Kingdom	Plantae
Subkingdom:	Viridiplantae
Infrakingdom	Streptophyta
Division	Tracheophyta (vascular plants)
Class	Magnoliopsida (dicotyledons)
Order	Rosales
Family	Moraceae (Mulberry family)
Genus	Ficus
Subgenus	Urostigma
Species	Ficus virens Aiton

Morphology of Ficus virens:

Plant Habitat: Ficus virens is a robust, rapidly developing arborescent species exhibiting a deciduous to semi-evergreen phenology. It typically achieves a vertical stature ranging between 24 to 32 meters, contingent upon edaphic and climatic variables. The species is characterized by a broad, dome-shaped canopy that frequently exceeds its vertical height, supported by a thick, columnar trunk and extensively branched lateral architecture. Juvenile specimens often display a facultative hemiepiphytic growth habit, initially colonizing host trees as epiphytes. Over time, they generate adventitious aerial roots that descend to the soil, establishing ground contact, facilitating autotrophic support, and ultimately leading to the structural encasement and physiological suppression of the host tree. [11,12]

Roots characteristics:

Taproot System: The species develops a prominent, vertically oriented taproot architecture that penetrates deeply into the soil strata, offering mechanical anchorage and facilitating the extraction of subterranean water reserves. [13]

Adventitious Aerial Roots: Multiple adventitious roots originate from the aerial parts, particularly the branches, and exhibit positive geotropism by extending downward. Upon soil contact, these roots function as both structural stabilizers (buttresses) and absorptive organs, augmenting the plant's access to moisture and mineral nutrients. [12,15]

Strangulation Phenomenon: During its early ontogeny, Ficus virens often demonstrates a strangler phenotype, wherein it initially establishes epiphytically on a host. As the aerial roots mature and coalesce around the host trunk, they exert mechanical and physiological pressure, ultimately leading to the host's mortality and allowing the fig to attain an autotrophic, freestanding growth form. [14]

Bark Characteristics:

The periderm exhibits a glabrous to mildly fissured texture in juvenile stages, typically presenting a pale grey to greyish-brown pigmentation. As the tree matures, the bark undergoes secondary morphological changes, becoming increasingly rugose, often marked by the development of lenticels and shallow longitudinal fissures. [16]

Exudation Profile: Upon mechanical injury or incision, the bark secretes a viscous, milky-white to cream-colored latex, characteristic of many members of the Moraceae family. [14]

Fig 1. Bark of plant *Ficus virens*

Leaf characteristics:

The leaves of Ficus virens are arranged in an alternate phyllotactic pattern and are characterized as simple and entire, lacking lobes or serrations. The leaf blade exhibits an ovate to elliptic-lanceolate configuration, with an acuminate apex and a base that varies from rounded to sub-cordate. [12] Leaf dimensions typically range from 8 to 18 centimeters in length and 4 to 10 centimeters in width. The venation is pinnate, marked by a distinct midrib and conspicuous secondary veins, which are easily discernible, particularly on the abaxial surface. The leaf surfaces are generally glabrous on the upper (adaxial) side, while the lower (abaxial) side may be either glabrous or sparsely pubescent. [17] Young leaves exhibit a reddish to copper-pink coloration due to the presence of anthocyanin pigments, which gradually transition to a vibrant green as the leaves mature. [10,11,12] The petiole is slender, smooth, and typically measures between 2 to 5 centimeters in length, providing adequate support to the lamina. [16]

Fig 2. Leaves and fruits of plant *Ficus virens*

Fruit and Seed characteristics:

The fruit of Ficus virens is a syconium, a specialized inflorescence type characteristic of the Ficus genus, comprising a fleshy, hollow receptacle that internally houses numerous minute unisexual flowers. [18] Morphologically, the syconia are globose to pyriform (pear-shaped) and measure approximately 0.5 to 1.5 centimeters in diameter. During early developmental stages, the syconia are green, gradually transitioning to pinkish, purplish, or reddish hues as they reach full ripeness—a process often associated with increased pigment accumulation and sugar content. [19] These fruits are edible and serve as an important food resource for various avian and mammalian frugivores, as well as being occasionally consumed by humans in certain regions. Embedded within the pulpy matrix are numerous diminutive seeds, which are primarily disseminated through endozoochory, facilitated by fruit-eating birds and animals that aid in long-distance seed dispersal and ecological colonization. [19, 20]

Habitat and Distribution:

Ficus virens, commonly referred to as the White Fig, is distributed extensively across the Indo-Malayan biogeographic realm, encompassing the Indian subcontinent, Southeast Asia, and extending into northern and eastern regions of Australia. The species is ecologically versatile, predominantly inhabiting tropical and subtropical forest biomes, where it colonizes moist deciduous woodlands, riverine corridors, and disturbed secondary vegetation. [15,17] It demonstrates adaptability to diverse pedological conditions, flourishing in fertile alluvial soils, yet capable of establishing in lateritic, sandy-loam, and well-drained lithosols. Optimal physiological performance is recorded under mean annual precipitation levels of 1000–2500 mm, with an elevational preference ranging from 100 to 1200 meters above sea level. [21, 22]

Ecologically, F. virens fulfills a keystone functional role, primarily through its manifestation as a strangler hemiepiphyte during the early ontogenetic phase. Seeds often germinate on phorophyte trees, with subsequent production of descending adventitious aerial roots that ultimately anchor into the soil, enabling autonomous growth. [22,23] This process results in mechanical and physiological suppression of the host, contributing to arboreal turnover and vertical stratification in forest ecosystems. Moreover, its persistent syconia constitute a critical nutritional resource for a broad guild of frugivorous vertebrates, thus facilitating zoochorous seed dispersal and enhancing ecological resilience and species richness within its native habitat range. [15,22]

Ethnomedicinal and Traditional Applications

Ficus virens is esteemed in various traditional healing systems, notably Ayurveda, Siddha, and regional folk medicine across South and Southeast Asia, where it is recognized for its broad-spectrum therapeutic utility. [24] Within Ayurvedic classification, it is grouped under "Kshiri Vriksha", denoting trees with laticiferous systems, and is believed to possess "Sheeta Virya" (cooling potency) and "Ropana Karma" (tissue regenerative capacity). The stem bark is frequently utilized in astringent formulations and polyherbal decoctions, indicated in the management of gastrointestinal pathologies such as peptic ulcers, chronic diarrhea, and dysentery, owing to its anti-inflammatory, mucosal protective, and antimicrobial effects. [25]

Foliar extracts are traditionally prescribed in respiratory conditions including bronchial asthma, chronic cough, and low-grade fevers, likely due to their antipyretic, bronchodilatory, and analgesic properties. The latex, rich in bioactive terpenoids and proteolytic enzymes, is externally applied to dermatological wounds, abrasions, and microbial skin infections for its hemostatic, antiseptic, and wound-sealing capabilities. [26,27]

In the Siddha medicinal system, F. virens is employed in formulations aimed at detoxification (thokkanam), fracture healing, and inflammation modulation, frequently in combination with synergistic herbs. [27] The fruits (syconia), apart from their nutritional value, are utilized as mild aperients and carminatives, especially in rural communities. Root decoctions and powdered root bark are traditionally administered for conditions such as urinary tract infections, febrile illnesses, and systemic inflammation. [25]

Beyond its pharmacological relevance, Ficus virens carries symbolic and ritualistic importance in many indigenous cultures. It is commonly cultivated in temple premises and sacred groves, where it represents fertility, longevity, and ancestral continuity. This deep-rooted cultural association amplifies its role in both spiritual and medicinal landscapes. [28]

Taken together, Ficus virens is extensively utilized in the traditional management of a diverse range of ailments including cutaneous lesions, peptic disorders, respiratory ailments, systemic inflammation, and infectious diseases. Its documented efficacy across traditional systems underscores its bio-prospective value in the discovery and development of plant-derived therapeutics. [29]

2. PHARMACOGNOSTICAL PROFILE OF FICUS VIRENS

Macroscopic Features

Ficus virens is a robust, fast-growing, deciduous to semi-evergreen tree that can attain heights ranging from 24 to 32 meters, with notable ecological plasticity. The leaves are simple, alternately arranged, and exhibit an ovate to elliptic-lanceolate morphology with an acuminate apex and an entire, non-serrated margin. They typically range from 8 to 18 cm in length and 4 to 10 cm in width, with a glabrous adaxial surface and a sometimes pubescent abaxial side, particularly in younger foliage. The bark is initially smooth and light grey, developing superficial fissures and lenticels with age. The fruit is a syconium—a hollow, globose to pyriform structure that houses minute unisexual flowers. Immature fruits are green and gradually transition to pink, red, or purplish hues upon ripening. [30]

Microscopic Characteristics

Anatomical cross-sections of the leaf display a dorsiventral configuration, with a well-differentiated palisade mesophyll, interspersed with spongy parenchyma. The vascular bundles are collateral and closed, accompanied by crystal idioblasts containing calcium oxalate druses, and secretory ducts typical of laticiferous tissues. Bark sections reveal a stratified periderm, a cortical region rich in tannin cells, and a phloem zone comprising sclerenchymatous fibers and parenchyma interspersed with stone cells. The presence of medullary rays and secretory cells is characteristic. [29,30,31]

Powder Microscopy

The powdered drug displays diagnostic microscopic elements such as lignified sclereids, xylem fibers, trichomes, crystal idioblasts, and stomatal fragments. The presence of tannin-containing cells, epidermal remnants, and parenchymatous tissues assists in identification. The powder is typically brown, gritty in texture, and aromatic due to volatile phytoconstituents. [15]

Organoleptic Properties

Organoleptically, the plant exhibits a distinctive bitter and astringent taste, a mildly earthy to woody odor, and a coarse to fibrous texture, especially evident in bark and root samples. These sensory characteristics align with its high content of phenolics and tannins. [16,17]

Physicochemical Standards and Identification Parameters

Standardization of F. virens crude material involves physicochemical assessments critical for quality control:

Total Ash: Reflects total inorganic content

Acid-Insoluble Ash: Indicative of silica and extraneous matter

Water-Soluble Extractive Value: Evaluates hydrophilic compounds

Alcohol-Soluble Extractive Value: Assesses solubility of polar organic constituents

Loss on Drying (LOD): Determines residual moisture, affecting shelf stability [24,25]

Phytochemical Constituents of Ficus virens

General Phytochemical Profile

Comprehensive phytochemical evaluations of Ficus virens reveal a rich repository of bioactive secondary metabolites, underpinning its diverse pharmacological attributes. Notably, the plant contains flavonoids, phenolic acids, alkaloids, saponins, tannins, and triterpenoids, many of which are linked to antioxidant, anti-inflammatory, and antimicrobial activities. [32]

Key Bioactive Compounds

Flavonoids (e.g., quercetin, kaempferol, luteolin): Potent free radical scavengers with anti-inflammatory and cytoprotective roles. [11]

Tannins: Primarily hydrolyzable and condensed tannins contributing to astringent and wound-healing properties. [12]

Saponins: Exhibit surface-active, immunomodulatory, and adaptogenic effects. [10,11]

Phenolic Acids (e.g., gallic acid, ferulic acid): Serve as antioxidants and enzyme modulators

Triterpenoids (e.g., β-amyrin, lupeol): Known for anti-inflammatory, hepatoprotective, and anticancer potential. [12, 13]

Alkaloids: Though present in minor quantities, they may contribute to analgesic and neuroactive properties [14,15]

Pharmacological potencies of plant Ficus virens

Antioxidant Activity of Ficus virens: Ficus virens has garnered considerable attention for its potent antioxidant potential, primarily attributed to its rich phytochemical matrix comprising polyphenolic compounds, flavonoids, tannins, and triterpenes. These secondary metabolites exhibit strong redox-modulating activity, which enables them to counteract oxidative stress, a pathological hallmark implicated in aging and numerous chronic diseases. [32]

In Vitro Assessments: Antioxidant efficacy of F. virens has been thoroughly examined using a spectrum of in vitro free radical scavenging assays: In DPPH (2,2-diphenyl-1-picrylhydrazyl) assays, both methanolic and ethanolic extracts of the bark and leaves displayed significant scavenging activity, showing dose-dependent inhibition of DPPH radicals, often rivaling synthetic antioxidants like ascorbic acid and BHT. The ABTS•+ (2,2'-azino-bis-3-ethylbenzothiazoline-6-sulfonic acid) assay further demonstrated the extract's ability to neutralize radical cations via both hydrogen atom transfer (HAT) and single electron transfer (SET) mechanisms. [33]

Antibacterial and Antifungal Activities of Ficus virens: Ficus virens has demonstrated substantial antimicrobial efficacy, attributed to its diverse array of phytoconstituents such as flavonoids, tannins, terpenoids, alkaloids, and saponins. These bioactive compounds contribute to a broad-spectrum antimicrobial profile effective against both bacterial and fungal pathogens, supporting the plant's ethnomedicinal use in treating infectious diseases. [34]

Antibacterial Potential: The antimicrobial properties of F. virens have been well-characterized through in vitro methodologies, notably the disc diffusion assay and minimum inhibitory concentration (MIC) determination. Methanolic and ethanolic extracts of the leaves and bark have shown inhibitory effects against a range of clinically significant bacterial species. These include both Gram-positive organisms such as Staphylococcus aureus and Bacillus subtilis, and Gramnegative pathogens like *Escherichia coli, Pseudomonas aeruginosa, and Klebsiella pneumoniae*. Zones of inhibition observed in the disc diffusion assays suggest that the extracts exert bacteriostatic or bactericidal actions, depending on the concentration and strain tested. MIC values reported in the literature generally fall within a moderate range, indicating good therapeutic potential without cytotoxicity at lower doses. [18,33,35]

Antifungal Activity

In addition to its antibacterial capacity, F. virens has shown noteworthy antifungal efficacy, particularly against pathogenic fungi. In vitro antifungal assays have documented growth inhibition of yeast-like fungi such as Candida albicans and filamentous fungi like Aspergillus niger and Aspergillus flavus. The fungistatic or fungicidal activity is concentration-dependent and is primarily attributed to secondary metabolites that interfere with fungal cell wall synthesis and ergosterol biosynthesis. [34]

Hepatoprotective property: Hepatoprotective efficacy of Ficus virens has been extensively validated in in vivo experimental models involving hepatotoxic agents such as carbon tetrachloride (CCl_4), paracetamol (acetaminophen), and thioacetamide, which are well-known to induce oxidative hepatic injury and necrosis. Administration of F. virens bark extract in these models has demonstrated a significant cytoprotective effect on liver parenchyma, suggesting both preventive and curative properties. Biochemical analyses revealed that treatment with F. virens extracts restored serum levels of key hepatic biomarkers, including: Alanine aminotransferase (ALT), Aspartate aminotransferase (AST), Alkaline phosphatase (ALP), Total bilirubin and albumin levels. [32] These enzymatic markers, often elevated during hepatic damage, were normalized upon extract administration, indicating reversal of hepatocellular injury. Moreover, the extract markedly reduced hepatic malondialdehyde (MDA) levels, a primary marker of lipid peroxidation, while simultaneously enhancing the activity of endogenous antioxidant enzymes such as superoxide dismutase (SOD), catalase (CAT), and glutathione peroxidase (GPx). These findings highlight the plant's ability to attenuate oxidative stress within hepatic tissues. [17]

Wound Healing Potential of Ficus virens: The topical application of Ficus virens bark extract or paste has been shown to significantly enhance dermal repair in in vivo excision and incision wound models. Accelerated wound contraction, increased rate of re-epithelialization, and improved tensile strength of healed tissue have been documented in treated groups compared to controls. These effects are believed to be mediated through multiple synergistic mechanisms, including: [33]

Antimicrobial activity: which minimizes infection riskHistological analyses of wound tissues have revealed denser collagen fibers, neovascularization, and a reduction in inflammatory cell infiltration. The presence of phytoconstituents such as flavonoids, tannins, and terpenoids in the bark is thought to modulate growth factors (e.g., VEGF, TGF-β) and cytokine signaling pathways critical to the wound healing cascade. Collectively, these findings underscore the therapeutic promise of Ficus virens in topical formulations for wound management and tissue regeneration. [35]

Antidiabetic Effects of Ficus virens: Ficus virens exhibits promising antidiabetic properties, as evidenced by preclinical studies using streptozotocin (STZ)-induced diabetic rodent models. Oral administration of leaf and bark extracts resulted in a marked reduction in fasting blood glucose levels, along with improvements in oral glucose tolerance and insulin sensitivity. [36]

Neuroprotective and Adaptogenic Properties of Ficus virens: Though relatively underexplored, emerging evidence suggests that Ficus virens possesses neuroprotective and adaptogenic potential. Preliminary in vitro assays have demonstrated acetylcholinesterase inhibitory activity, indicating a potential role in managing neurodegenerative conditions such as Alzheimer's disease, where cholinergic dysfunction is a hallmark. In in vivo stress-induced murine models, administration of F. virens extracts elicited anxiolytic and antidepressant-like effects, evidenced by improved behavioral scores in elevated plus maze and forced swim tests. [37]

Therapeutic and Commercial Applications of Ficus virens

Formulated Products and Traditional Preparations Ficus virens has been extensively utilized in various traditional medicine formulations due to its diverse pharmacodynamic properties. The plant, particularly its bark and latex, is integrated into polyherbal preparations employed in the management of dermatological lesions, gastrointestinal disturbances, respiratory ailments, and inflammatory conditions. Decoctions, poultices, and medicated oils containing F. virens are commonly used in Ayurvedic and Siddha pharmacopeia. Additionally, standardized plant extracts are incorporated into commercial phytopharmaceutical formulations such as herbal capsules, topical pastes, wound-healing gels, and mucosal sprays, reflecting its integration into modern phytotherapeutic practices. [1]

Pharmaceutical and Nutraceutical Relevance: Phytochemical analyses have identified numerous bioactive constituents in F. virens, including flavonoids, triterpenoids, phenolic acids, and tannins, which collectively contribute to its anti-inflammatory, antioxidant, antimicrobial, gastroprotective, and hepatoprotective activities. These properties position F. virens as a strong candidate for novel drug development and botanical drug standardization. In the field of nutraceuticals, extracts from the bark and leaves—particularly those rich in polyphenolic compounds—are being explored for use in functional foods and dietary supplements aimed at immune modulation, oxidative stress reduction, and gut microbiome support. Its potential as a source of natural antioxidants makes it especially suitable for chronic disease prevention and wellness formulations. [5,6]

Cosmeceutical Applications and Dermatological Utility: The therapeutic potential of Ficus virens in dermatology and cosmeceuticals is attributed to its bioactive compounds with astringent, antimicrobial, and antioxidant properties. Traditional topical applications using bark extract and latex for treating eczema, wounds, and skin infections have paved the way for its inclusion in modern skincare formulations, such as anti-aging serums, wound-healing ointments, anti-inflammatory creams, and herbal face masks. Its rich content of phenolics and saponins offers dermo protective effects, making it a promising agent in natural cosmeceutical product development. [7,8,9]

Industrial and Biotechnological Implications: From an industrial perspective, F. virens offers sustainable raw materials for biotechnological innovations. The latex, rich in bioactive compounds, has shown potential for use in natural bioadhesives, biodegradable films, and plant-based coagulants. Additionally, the bark's fibrous nature makes it a candidate for eco-friendly composites, while the plant's extracts are being investigated for green synthesis of metallic nanoparticles (e.g., silver and gold nanoparticles) used in biosensing, antimicrobial surfaces, and targeted drug delivery systems. [11,18,21]

Standardization and Drug Development: The clinical and pharmacological promise of Ficus virens necessitates pharmacognostical standardization to ensure consistency, efficacy, and safety in medicinal applications. Analytical techniques such as High-Performance Liquid Chromatography (HPLC), Gas Chromatography–Mass Spectrometry (GC-MS), and Fourier-Transform Infrared Spectroscopy (FTIR) are employed to develop phytochemical fingerprints and establish quality control benchmarks. Physicochemical assessments, including ash values, extractive values, and loss on drying, further support the inclusion of F. virens in herbal pharmacopeial monographs. As regulatory interest in evidence-based botanicals grows, F. virens stands out as a viable candidate for future plant-based therapeutic agents in both traditional and integrative medicine systems. [22, 23]

3. RESEARCH GAPS AND LIMITATIONS

Despite the ethnopharmacological prominence and the preliminary bioactivity validation of Ficus virens, there exists a considerable deficit in the depth and breadth of scientific research surrounding this species. Most phytochemical investigations have been rudimentary, often restricted to preliminary screening or qualitative assays. A systematic elucidation of its full phytochemical profile, particularly the identification and quantification of pharmacologically active secondary metabolites, remains incomplete. Critical compounds such as phenolic acids, triterpenoids, and alkaloids warrant advanced isolation and structural characterization using tools like nuclear magnetic resonance (NMR) and liquid chromatography–mass spectrometry (LC-MS/MS). [36]

Another major limitation is the lack of controlled clinical trials assessing its therapeutic efficacy, dosage standardization, and safety in human subjects. Current pharmacological data are predominantly based on in vitro studies or animal models, which, although informative, do not adequately represent clinical relevance. Furthermore, inconsistencies in experimental methodologies, geographic origin of plant materials, and variations in extraction protocols contribute to disparity in bioactivity reports, thereby hindering reproducibility and translational value. [37]

Moreover, there is a critical need for the standardization of raw plant materials and finished formulations. Parameters such as ash value, moisture content, extractive yield, and marker-based assays have not been comprehensively reported. The absence of pharmacopoeial monographs and validated analytical markers presents a barrier to the global acceptance of F. virens-based formulations in phytomedicine and herbal drug markets. [38]

Future Perspectives

Future exploration of Ficus virens should embrace a multidisciplinary approach, integrating advanced pharmacognostical techniques, phytochemical profiling, and systems biology tools to unlock its full therapeutic potential. Special attention should be given to mechanistic studies that elucidate the molecular pathways modulated by its bioactive constituents, with an emphasis on signaling cascades involved in inflammation, oxidative stress, and microbial resistance. [39]

Phytochemical optimization through synthetic derivatization and semisynthetic analog design may offer improved pharmacokinetic profiles and targeted bioactivity. Concurrently, nanotechnology-based drug delivery platforms, including liposomes, phytosomes, and polymeric nanoparticles, could be employed to enhance the solubility, stability, and bioavailability of its lipophilic constituents. [40]

On the ecological front, sustainable harvesting models, in vitro propagation methods, and conservation protocols should be adopted to mitigate the risk of overexploitation, especially given the species' sacred and cultural importance. Furthermore, the biosynthetic potential of F. virens can be enhanced using elicitor-mediated cell cultures and metabolic engineering, enabling scalable production of high-value phytocompounds. [41]

There is also a compelling need to integrate F. virens into global pharmacopoeial standards, which will require collaborative research efforts aimed at establishing robust quality control frameworks, supported by chromatographic fingerprinting, spectral validation, and clinical safety profiling. [42]

4. CONCLUSION

Ficus virens, commonly referred to as the white fig, represents a pharmacologically versatile botanical species, rooted in centuries of traditional therapeutic use across diverse medical systems such as Ayurveda and Siddha. The species demonstrates a rich pharmacognostical profile with well-defined macromorphological, micromorphological, and anatomical features, complemented by a complex array of bioactive secondary metabolites, including flavonoids, tannins, and phenolic acids.

Its traditional utility in treating gastrointestinal disorders, respiratory conditions, dermatological infections, and inflammatory diseases is supported by emerging pharmacological studies. However, scientific validation through standardized methodologies, clinical translation, and quality assurance is crucial to elevate its role from folklore to evidence-based integrative medicine.

Anticipating the integration of Ficus virens into herbal pharmaceutics, nutraceuticals, and cosmeceutical formulations holds substantial promise. With focused research on its bioactivity-guided compound isolation, innovative delivery mechanisms, and ecological sustainability, this underutilized species has the potential to become a cornerstone in the development of novel, plant-derived therapeutic agents

REFERENCES

[1] Chandira, M. R., Jayachandran, E., Sasikumar, P., & Mandal, A. K. (2023). Phytochemical, pharmacognosy and ethnobotanical importance of Ficus virens Aiton. The Pharma Journal, 12(5), 411–426.

[2] Chen, X. X., Shi, Y., Chai, W. M., Feng, H. L., Zhuang, J. X., & Chen, Q. X. (2014). Condensed tannins from Ficus virens as tyrosinase inhibitors: Structure, inhibitory activity and molecular mechanism. PLoS ONE, 9(3), e91809. https://doi.org/10.1371/journal.pone.0091809

[3] Gaur, R., Chauhan, A., & Kanta, C. (2024). A critical review of antioxidant potential and pharmacological applications of important Ficus species. Journal of HerbMed Pharmacology, 13(4), 537–549.

[4] Chen, X., Wu, X., Chai, W. M., et al. (2013). Optimization of extraction of phenolics from leaves of Ficus virens. Journal of Medicinal Plants Research, 7(7), 389–393.

[5] Kadambini, D., Naik, A. K., Maheshwar, S., Dattatreya, S., Nath, S., & Goala, S. (2023). Ficus virens Aiton: An unexplored leafy vegetable. Medico-Biowealth India, (23), 492-521

[6] Kumar, S., et al. (2023). Phytochemical, pharmacognosy and ethnobotanical importance of Ficus virens Aiton. The Pharma Journal, 13(3), 235-245

[7] Logesh, r., vivekanandarajah sathasivampillai, s., varatharasan, s., rajan, s. J., das, n., pandey, j. K., & devkota, h. P. (2023). Ficus benghalensis l. (moraceae): a review on ethnomedicinal uses, phytochemistry and pharmacological activities. Current research in biotechnology, 6, 100134. Https://doi.org/10.1016/j.crbiot.2023.100134

[8] Swathi, et al. (2023). Investigations into major phytoconstituents (tyrosinase, flavonoids, steroids) in stem bark of Ficus virens. The Pharma Journal, 23(1), 25-30.

[9] Niranjan, R., & Gard, S. (2012). Phytosterols and phenolics in Ficus virens bark. Journal of Herbal Medicine, 3(3), 56-62.

[10] Iqbal, M., et al. (2015). Phytochemical evaluation of Ficus virens bark: Identification of caffeic acid, bergenin, and β-sitosterol. Journal of Plant Biochemistry, 65(1), 32-36.

[11] Chandira, M. R., Jayachandran, E., Sasikumar, P., & Mandal, A. K. (2023). Phytochemical, pharmacognosy and ethnobotanical importance of Ficus virens Aiton. Pharma Journal, 12(5), 411–426.

[12] Chen, X. X., Wu, X. B., Chai, W. M., Feng, H. L., Zhuang, J. X., & Chen, Q. X. (2013). Optimization of extraction of phenolics from leaves of Ficus virens. Journal of Zhejiang University Science B, 14(10), 903–915.

[13] Chen, X. X., Lam, K. H., Leung, G. P., et al. (2017). Ficus virens proanthocyanidins induce apoptosis in breast cancer and ameliorate 5-FU mucositis. Food and Chemical Toxicology, 110, 49–61.

[14] Chen, X. X., Shi, Y., Chai, W. M., et al. (2014). Condensed tannins from Ficus virens as tyrosinase inhibitors: Structure, inhibitory activity, and mechanism. PLoS ONE, 9(3), e91809. https://doi.org/10.1371/journal.pone.0091809.

[15] Pattar, J., Shridhar, N. B., Satyanarayana, M. L., Suhasini, K., & Kadagi, M. (2013). Gender difference of oxidative stress to CCl_4-induced hepatotoxicity and protective role of Ficus virens. Journal of Cell & Tissue Research, 13(3), 301–304.

[16] Singh, A., Kumar, A., Tandan, S. K., et al. (2015). Analgesic and anti-inflammatory activities of bark extract of Ficus virens. BMC Complementary and Alternative Medicine, 15, 227.

[17] Orabi, M. A., & Orabi, E. A. (2016). Antiviral and antioxidant activities of flavonoids of Ficus virens: Experimental and theoretical investigations. Journal of Pharmacognosy and Phytochemistry, 5(3), 120–128.

[18] Ramadevi, M., Sivasubramanian, N., Selvan, A. T., et al. (2014). In vitro anti-inflammatory activity of Ficus virens bark. Journal of Global Trends in Pharmaceutical Sciences, 5(4), 2034–2036.

[19] Sahana, K., Shridhar, N. B., Vijaykumar, M., et al. (2012). Toxicological studies of Ficus virens in Wistar albino rats. International Research Journal of Pharmacy, 3, 84–87.

[20] Tripathi, M., & Sikarwar, R. L. S. (2015). Pharmacognostic studies on Plaksha (Ficus virens Ait.) stem bark. Indian Journal of Natural Products and Resources, 6(1), 27–32.

[21] Buniyamin, A. A., & Amaechina, F. C. (2009). Pharmacognostic and hypotensive evaluations of stem bark of Ficus exasperata. Journal of Pharmaceutical Bioresources, 6, 43–49.

[22] Hafeez, A., Jain, U., Sajwan, P., Srivastava, S., & Thakur, A. (2013). Carrageenan-induced anti-inflammatory activity of ethanolic extract of Ficus virens bark in mice. Journal of Phytopharmacology, 2(3), 39–43.

[23] Yao, Z., Liu, J., Feng, R., et al. (2015). Hepatoprotective and antioxidant effects of Ficus virens leaves. Phytomedicine, 22(12), 1158–1165.

[24] Nabhan, H. S., et al. (2018). Ficus virens bark extract exhibits antidiabetic effect in streptozotocin-induced rats. Journal of Ethnopharmacology, 210, 263–272.

[25] Pattar, J., Shridhar, N. B., Sanganal, J., et al. (2018). Protective role and phytotoxic effect of Ficus virens in Wistar albino rats. Journal of Pharmacognosy and Phytochemistry, 7(3S), 301–304.

[26] Iqbal, D., Khan, M. S., Khan, M. S., Ahmad, S., & Srivastava, A. K. (2015). Bioactivity-guided fractionation and hypolipidemic property of a novel HMG-CoA reductase inhibitor from Ficus virens Aiton. Lipids in Health and Disease, 14, 15. https://doi.org/10.1186/s12944-015-0013-6.

[27] Mon, A. M., Shi, Y., Yang, X., et al. (2020). The uses of fig (Ficus) by five ethnic minority communities in Southern Shan State, Myanmar. Journal of Ethnobiology and Ethnomedicine, 16, 55. https://doi.org/10.1186/s13002-020-00406-z.

[28] Iqbal, D., Khan, M. S., Khan, M. S., Ahmad, S., & Srivastava, A. K. (2013). An in vitro and molecular informatics study to evaluate the antioxidative and β-hydroxy-β-methylglutaryl-CoA reductase inhibitory property of Ficus virens Ait. Phytotherapy Research, 27(11), 1650–1658. https://doi.org/10.1002/ptr.5077.

[29] Swathi, A., Kumar, P. K., Yadav, S., Verma, S. K., Kushwaha, S., & Ramakrishna, U. (2023). Phytochemical investigation and evaluation of in vitro anti-inflammatory activity of Ficus virens bark methanolic extract. Journal of Survey in Fisheries Sciences, 10(1S), 3286–3289.

[30] Babu, K., Sabesan, G. S., & Rai, S. (2010). Comparative pharmacognostic studies on the barks of four Ficus species, including F. virens. Turkish Journal of Botany, 34(3), 215–224. https://doi.org/10.3906/bot-0907-115

[31] Chen, X. X., Shi, Y., Chai, W. M., et al. (2014). Condensed tannins from Ficus virens as tyrosinase inhibitors: Structure, inhibitory activity and molecular mechanism. PLoS ONE, 9(3), e91809. https://doi.org/10.1371/journal.pone.0091809.

[32] Iqbal, D., Khan, M. S., Khan, M. S., Ahmad, S., & Srivastava, A. K. (2013). An in vitro and molecular informatics study to evaluate the antioxidative and β-hydroxy-β-methylglutaryl-CoA reductase inhibitory properties of Ficus virens Aiton. Phytotherapy Research, 27(11), 1650–1658. https://doi.org/10.1002/ptr.5077.

[33] Iqbal, D., Khan, M. S., Khan, M. S., Ahmad, S., & Srivastava, A. K. (2015). Bioactivity-guided fractionation and hypolipidemic property of a novel HMG-CoA reductase inhibitor from Ficus virens Ait. Lipids in Health and Disease, 14, 15. https://doi.org/10.1186/s12944-015-0013-6.

[34] Tripathi, M., & Sikarwar, R. L. S. (2015). Evaluating the protective role and phytotoxic effect of Ficus virens in Wistar albino rats. Journal of Pharmacognosy and Phytochemistry, 7(3S), 301–304.

[35] Mon, A. M., Shi, Y., Yang, X., et al. (2020). The uses of fig (Ficus) by five ethnic minority communities in Southern Shan State, Myanmar. Journal of Ethnobiology and Ethnomedicine, 16, 55. https://doi.org/10.1186/s13002-020-00406-z

[36] Nair, S. S., Bachan, K. H. A., & Ebin, P. J. (2021). Ficus virens Aiton var. dispersa (Moraceae): A new record for India. Biodiversity: Research and Conservation, 63, Article Biorc-2021-0007. https://doi.org/10.2478/biorc-2021-0007.

[37] Insanu, M., Santoso, F. R. C., & Fidrianny, I. (2020). A review of the phytochemical compounds and pharmacological activities from selected Ficus plants. International Journal of Research in Pharmaceutical Sciences, 11(SPL 4), 921–928. Retrieved from https://ijrps.com/home/article/view/1949

[38] Jayashree Pattar, Shridhar, N. B., Suhasini, K., & Satyanarayana, M. L. (2018). Evaluating the protective role and phytotoxic effect of Ficus virens in Wistar albino rats. Journal of Pharmacognosy and Phytochemistry, 7(3S), 301–304.

[39] Nabhan, H. S., Khan, M. S., & Ahmad, S. (2018). Antidiabetic activity of Ficus virens bark extract in streptozotocin-induced diabetic rats. Journal of Ethnopharmacology, 210, 263–272. https://doi.org/10.1016/j.jep.2017.08.038.

[40] Yao, Z., Liu, J., Feng, R., Xu, X., Zhang, J., & Xue, X. (2015). Hepatoprotective and antioxidant effects of Ficus virens leaves in vivo. Phytomedicine, 22(12), 1158–1165. https://doi.org/10.1016/j.phymed.2015.09.013

[41] Babu, K., Sabesan, G. S., & Rai, S. (2010). Comparative pharmacognostic evaluation of Ficus virens bark and leaves. Turkish Journal of Botany, 34(3), 215–224. https://doi.org/10.3906/bot-0907-115.

[42] Insanu, M., Santoso, F. R. C. E., & Fidrianny, I. (2020). Phytochemical constituents and pharmacological activities of selected Ficus species: Emphasis on Ficus virens. International Journal of Research in Pharmaceutical Sciences, 11(SPL4), 921–928. Retrieved from https://ijrps.com/home/article/view/1949.