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PHYTOCHEMICALS, PHARMACOLOGICAL PROPERTIES AND TRADITIONAL USES OF FICUS NATALENSIS: A COMPREHENSIVE REVIEW

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ABSTRACT: *Ficus natalensis*, commonly known as the Natal fig, belongs to the family of Moraceae, *Ficus natalensis* is a species of fig tree native to tropical Africa. This evergreen tree is widely distributed in the region, growing up to 30 meters in height. *Ficus natalensis* has a broad range of uses, including medicinal, economic, and ecological applications. The tree's bark, stem, leaves, and fruits are used in traditional medicine to treat various ailments, such as fever, rheumatism, skin conditions, Anti- bacterial, Anti-microbial, Anti– adhesion potential, Anti-inflammatory, Hepato protective and also this species passes other activities like Pyrolytic conversion of novel biomass, Fibrous microcrystalline cellulose, The wood is valued for furniture-making and construction, while the fruits are edible and a favorite food source for various bird species. *Ficus natalensis* also plays a crucial role in maintaining ecosystem balance. An overview of studies conducted on the *Ficus natalensisis* plant is presented in this article. It includes discussion on taxonomy, classification, common name, description, distribution, phytochemicals and pharmacological activities and other activities.

INTRODUCTION: The term "Pharmacognosy," which refers to studies on natural product drugs, has been used for almost 200 years as a constituent scientific discipline of pharmacy. During the last half of the 20th century, Pharmacognosy changed from being a descriptive botanical subject to one with a more chemical and biological focus. The use of herbal remedies, or "Phytomedicines," in modern Pharmacy practice, especially in Western Europe and North America, has grown rapidly, giving Pharmacognosy teaching in academic pharmacy institutions new significance at the start of the 21st century.

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Pharmacognosy study fields, on the other hand, are still growing and now encompass not only the more conventional analytical method development and Phytochemistry, but also aspects of cell and molecular biology in relation to natural products, ethnobotany, and phytotherapy. In order to clarify new plant-derived cancer chemotherapeutic agents and novel cancer chemopreventives, respectively, two multidisciplinary natural product drug discovery programs yielded promising bioactive molecules, examples of which are given in this study.

The systematic study of herbal remedies offers pharmacognosy groups an attractive new area of research, ranging from investigating the biologically active principles of phytomedicines and their mode of action and potential drug interactions, to quality control, and involvement in clinical trials [1].

There are roughly 850 species in the genus *Ficus*, which belongs to the Moraceaea family. There are roughly 200 different types of Ficus found in tropical and subtropical woods as woody trees, shrubs, and vines. There are over 500 *Ficus* species in Asia and Australia, and they are high in nutritious elements. In traditional medicine, *Ficus* species are well-known for their abundance of flavonoids and phenolic acid, which help them protect against oxidative stress disorders. Plant extracts from these species have been shown to be useful in treating diabetes, stomachaches, piles, dysentery, inflammation, oxidative stress, and cancer. The anti-cancer, anti-inflammatory, and anti-diabetic properties of Ficus plants have also been used to promote their ethano-medical usage [2]. The evergreen or soon-deciduous tree or shrub *Ficus natalensis* can reach a height of 10 to 30 meters and has a crown that spreads widely. It frequently begins as an epiphyte in a tree branch before sending down aerial roots that, once they reach the ground, supply additional nutrients that support the plant's faster growth. When combined with the more vigorous top growth, these aerial roots have the ability to completely wrap the host tree's trunk, restricting its growth and perhaps causing the fig to outcompete and kill the tree it is growing on [3].

FIG. 1: FICUS NATALENSIS TREE

FIG. 2: FICUS NATALENSISFRUIT

FIG. 3: FICUS NATALENSIS LEAFS

Taxonomical Classification:

Kingdom: Plantae

Clade: Tracheophytes

Clade: Angiosperms

Clade: Eudicots

Clade: Rosids

Order: Rosales

Family: Moraceae

Genus: Ficus

Species: Ficus natalensis

Common Names: Natal fig, Mistltoe fig, Triangular leaf fig.

Botanical Name: *Ficus Natalensis subsp, leprieurii* [4]

Synonyms: *F. triangularis* Warb [17]

Vernacular Names:

Afrikaans: Natalvy

English: Bark cloth fig, natal fig

German: Natal feige [19]

Kannada: Kallathi

Description of *Ficus natalensis:* The genus *Ficus* is a rich genetic resource due to its high nutritional and economic significance. It is also an important component of the rainforest's biodiversity. Even leaves on the same tree can have different shapes, and characteristics like cordate bases and acuminate ends are rarely constant. The leaves have cordate, ovate, and elliptic shapes; their bases are cordate and obtuse; their margins are serrate, whole, and scalloped; and their apexes are acute, obtuse, and acuminate. The number of leaves varied significantly among all species except *Ficus reliogosa, Ficus polita, Ficus platyphylla, and F. natalensis*, according to a quantitative analysis of the foliar characteristics in both the wet and dry seasons characteristics of *Ficus* species vary significantly between the wet and dry seasons [5].

An evergreen shrub or tree usually 12 m but up to 30 m with upright branches to a dense drooping crown. Aerial roots may hang down from the branches and the base of the trunk is often a mass of interwoven roots.

Bark: pale grey, thin and smooth.

Leaves: Rather stiff, long oval, often wider at the tip, about 6 cm (2.5-10 cm) long, tip rounded or shortly pointed, 5-10 veins on either side, on a stalk 0.5-2.0 cm long.

Figs: in pairs beside or just below leaves on stalks 2-10 mm, rounded yellow-red when ripe 8-18 mm across, 2 mm long, bracts at the base fall off [18].

Chemical Composition: Eleven chemicals, including one ceramide, two anthraquinones, four triterpenes, two polyols, and two steroids were found through phytochemical analysis of the stem bark of *Ficus natalensis.* Spectroscopic techniques such as infrared, ultraviolet, mass spectrometry, 1D- and 2D- NMR (1H, 13C, 1H–1H COSY, HMQC, HMBC, and NOESY), There was no action in any of the substances examined. In the current investigation, compounds in this study were isolated for the first time from the species *F. natalensis*; compounds 2, 4–7, 10, and 11 were previously reported [6].

Essential Oil Composition Present in Leaves: (E)-Phytol (37.6%), 6, 10, 14-trimethyl-2-pentadecanone (24.9%), geranyl acetone (2.8%), hexadecanoic acid (2.0%), carophyllene oxide (1.7%), oleic acid (1.6%), β-ionone (1.2%), octacosane (1.1%), α-ionone (0.9%), β-carophyllene (0.7%), heptacosane (0.6%), neral (0.5%), octadecanoic acid (0.5%), benzaldehyde (0.3%), (E)-menth-2-en-1-ol (0.3%), limonene (0.3%), n-nonanal (0.2%), Z-menth-2-en-1-ol (0.2%), 1-octen-3-ol (0.2%), isophytol (0.2%), 6-methyl-5-hepten-2-one (0.2%), linalool (0.1%), 3,4-dimethyl toluene (0.1%), α-pinene (0.1%). Total (78.3%) [7].

Phytochemical Investigation Stem Bark: Phytochemical investigation of the stem bark of *Ficus natalensis* afforded eleven compounds including one ceramide, two anthraquinones, four triterpenes, two polyols and two steroids. The structures of the compounds were determined by spectroscopic analyses including IR, UV, MS, 1D- and 2D- NMR (^{1}H, ^{13}C, ^{1}H–^{1}H COSY, HMQC, HMBC and NOESY) [8].

Ethnomedical Uses: Malaria, influenza, ulcers, whooping cough, dysentery, treating wounds, warts and septic ears (skin conditions), irregular and painful menstruations, to ease childbirth, induces lactation, arthritis, eye cataract, headache, as an antivenom [17].

Pharmacological Activities:

Anti- Microbial Activities: Phytochemical screening, antimicrobial and antioxidant potential of the bark and leaves extracts of *Ficus natalensis* were carried out by using various techniques. Phytochemical analysis showed the presence of terpenoids, alkaloids, flavonoids, tannins, saponins, cardiac glycosides and reducing sugars in different extracts of *Ficus natalensis*. The antibacterial potential against *S. aureus* was reported as most promising amongst all. The methanol bark extract's antifungal potential was 43.7 ± 1.527 mm, and the petroleum ether extracts of bark with zones of inhibition 37 ± 0.577 mm against *A. niger* showed the most prominent activity. The extracts were screened for antioxidant potential using various assays, and the estimation of antioxidant activity by metal chelating activity showed that water extract of leaves was the most active with a value of 74.673 ± 0.302 percentage bound iron. The petroleum ether extracts of leaves with a zone of inhibition 50 ± 0.51 mm and bark extracts with a zone of inhibition 55.7 ± 1.15 mm inhibited *S. aureus*, and the chloroform leaves extract also showed an inhibition zone of 50 ± 2 mm against this pathogen Chloroform extract of bark had the highest flavonoid content (1005.53 ± 0.503 mg/mL of quercetin), while chloroform extract of leaves had the highest phenolic content (21.626 ± 0.545 mg/g of GAE). In the ABTS assay, the water extract of leaves had the highest TEAC value (7.713 ± 0.7 mM of trolox equivalent), and the distilled water extract of bark had the highest percentage of free radical scavenging DPPH (91.92 ± 0.08%) [9].

Anti-Inflammatory: Inflammation is an immunological response of the body against outside harmful substances. Diabetes, heart disease, arthritis, and cancer are all linked to chronic inflammation. The purpose of this study is to examine the plant *Ficus natalensis* subspecies leprieurii's capacity to reduce inflammation. Several leaf extracts from *F. natalensis* were examined for bioactive phytochemicals and evaluated utilizing anti-inflammatory *in-vitro* activity. The method of carrageenan-induced paw edema was also used to investigate the anti-inflammatory capabilities *in-vivo*. Potential anti-inflammatory effects were demonstrated by this plant in an *in-vitro* protein denaturation test. When compared to the conventional medication, the *in-vivo* assay showed that n-hexane extract had the highest percentage inhibition of paw volume (83.49%). Bioactive phytochemicals were tentatively identified by GC-MS analysis of nhexane extract, and their activity was then assessed using molecular docking. According to the findings, gamma tocopherol has the strongest affinity for binding BSA. According to the findings, *F. natalensis* has potential as an anti-inflammatory and has therapeutic use [10].

Hepatoprotective: The ethanolic extracts showed changes in the indices of liver function as well as enlargement of the liver in a dose-specific manner; all the serum enzyme activity of ALT, AST, and GGT was increased in a dose-dependent manner; this could be due to hepatotoxicity caused by the metabolites of the *Ficus natalensis*. The cold water extraction may have extracted all the active ingredients, including some that were toxic to the laboratory animals and caused their death [11].

Other Activities:

Anti-Adhesion Potential of Non-Polar Compounds: Using leaf, stem, and bark extracts, four triterpenoids-ergosta-4,6,8(14),22-tetraene-3-one 1, stigma-4-ene-3-one 2, 3-hydroxy21-H-hop-22(29)-ene 3, sitosterol 4, and a quinone, tectoquinone 5 have been identified. *Ficus natalensis* is a medicinal fig that is commonly found in South Africa. The antibacterial activity of the crude extracts and pure compounds 1–5 against five Gram-negative and seven Gram-positive microorganisms, as well as their possible anti-biofilm activity, were evaluated. All pure substances evaluated at 250 µg showed antimicrobial susceptibility against most Gram-positive and Gram-negative bacteria. Up to ten of the twelve bacterial strains exhibited broad spectrum antibiotic activity for compounds 2, 3, and 5Compound 3, 3-hydroxy-21-H-hop-22(29)-ene was effective against all Gram-positive test organisms, while the crude extracts exhibited no discernible antimicrobial activity. In the anti-biofilm assay, exposure to EtOAc, MeOH, and aqueous MeOH leaf, stem bark, and fruit extracts reduced adhesion with a 100% biofilm reduction for all three tested organisms: *Escherichia coli*, *Pseudomonas aeruginosa*, and *S. aureus*. The MeOH leaf extract showed the strongest anti-adhesion potential against E. coli (218.11% biofilm reduction), while stigma-4-ene-3-one 2, 3-hydroxy-21-H-hop-22(29)-ene 3, and tectoquinone 5 were the most effective anti-adhesion against *P. aeruginosa* at the lowest concentration tested (100 µg mL-1 [12].

Fibrous Microcrystalline Cellulose from *Ficus natalensis*: In this study, *Ficus natalensis* bark cloth was hydrolyzed with acid to produce microcrystalline cellulose (MCC) with an overall yield of 30.9%. MCC showed an initial thermal degradation temperature of 314.6 °C and a high crystallinity index of 75.8%. According to morphological investigations, the MCC particles were fibrous rod-like and had slightly rough surfaces. Their average diameter and length were 17.08 ± 3.3 μm and 90 ± 25 μm, respectively. Therefore, the range of uses for barkcloth as fillers in biocomposites is increased by the thermally stable fibrous MCC produced from this study [13].

Pyrolytic Conversion of a Novel Biomass *Ficus natalensis* Barkcloth: The over dependence on fossil fuels to generate electricity has led to a concerning depletion of petrochemical crude oil supplies, which is also the reason for increased greenhouse gas emissions. Because of their carbon-neutral and regenerative qualities, biomass resources are regarded as possible future fuels. The physicochemical properties and pyrolysis behavior of a novel biomass, *Ficus natalensis* barkcloth (FNB), are presented in this study. According to physicochemical characterisation, the FNB's primary chemical constituent is 67% cellulose, it has a higher heating value (HHV) of 13.8 MJ/kg, and its volatile matter contents are 74.4%.

Thermogravimetric analysis (TGA) revealed that under inert thermal deterioration, the core devolatization (235°C to 410°C) experienced the most breakdown. The kinetics triplet for FNB biomass was calculated using model-free and model-fitting kinetic approaches on TGA data. It was found that the FNB pyrolysis process had an average activation energy (Ea) of 168 kJ/mol. For the pyrolysis of FNB at high heating rates, the compensating effects between pre-exponential factor (A) and Ea revealed an increase in collision intensity. The pyrolysis of FNB followed the first-order reaction (F1) mechanism, according to the Criado master plot data. To assess the evolution of thermal degradation, thermodynamic parameters including change in enthalpy (ΔH), Gibbs free energy (ΔG), and entropy (ΔS) were also computed and compared with kinetics parameters. FBN's bioenergy potential was shown to be comparable to that of existing biomasses by physiochemical and thermokinetic studies [14].

Novel Pretreatments Performance Evaluation for Cellulose Nanofibrils: Recently, there has been a lot of interest in the extraction of nanosized cellulose molecules from sustainable material sources. The extraction of cellulose nanofibrils (CNF) using environmentally friendly bio-based materials has drawn significant scientific attention. The efficiency of pretreating *Ficus natalensis* barkcloth cellulose (FNBC) for CNF synthesis prior to 2, 2, 6, 6,-tetramethylpiperidine-1-oxyl (TEMPO) oxidation was investigated in this study using dimethyl sulfoxide (DMSO). The structural and morphological alterations were used to assess DMSO's pretreatment efficacy. Comparing DMSO-pretreated FNBC to untreated cellulose samples, the former showed the most pronounced morphological alterations. The results of the transmission electron microscope (TEM) and scanning electron microscope (SEM) demonstrate that there is a significant structural disruption of FNBC during the pretreatment process. This may be due to the exceptional ability to remove amorphous regions and non-cellulosic materials from the FNBC, which is supported by the larger crystallinity values and higher thermal stabilities values of pretreated FNBC samples that are shown by X-ray diffractometry (XRD) were observed as well.

All things considered, this study demonstrated a very successful and innovative pretreatment technique for fractionating FNBC, which will encourage the subsequent extraction of cellulose nanofibrils. Additionally, this study demonstrated that *F. natalensis* barkcloth could be regarded as an alternate source of cellulose for possible value-added industrial applications like the food industry, papermaking, and biomedicines based on cellulose and CNF characterizations [15].

CONCLUSION: The *ficus natalensis* plant has valuable phytochemicals used in medicine and other fields. It has promising results in several biological activity tests, including Anti-bacterial, Anti-inflammatory, hepatotoxicity and Antioxidant action. Further research on *Ficus natalensis* is required to uncover its further secrets

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