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Original Research Article

Unveiling the Pharmacological Potential of Philippine *Ficus* Species: A Systematic Review With Network Analyses of Bioactive Compounds and Its Therapeutic Effects

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ABSTRACT

The genus *Ficus* (*Moraceae*) comprises a diverse group of species with notable ethnobotanical and pharmacological significance, particularly in tropical regions such as the Philippines. The systematic review, conducted using 2020 PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) guidelines, aims to synthesize information on the chemical constituents, traditional uses, and pharmacological potential of Philippine *Ficus* species. A comprehensive search of the Google Scholar database identified relevant studies detailing phytochemical profiles, ethnobotanical applications, and bioactive properties.The study highlights the phytochemical diversity of Philippine *Ficus* species, including flavonoids, alkaloids, phenolic acids, and other secondary metabolites with recognized therapeutic properties. Traditional practices document the use of these plants to address ailments like inflammation, gastrointestinal disorders, and infections, while pharmacological studies reveal antioxidant, anti-inflammatory, antimicrobial, and anticancer activities, validating traditional uses. Network analyses using Gephi version 0.10.1 elucidated the relationships between *Ficus* species, their bioactive compounds, and corresponding pharmacological benefits. Key research gaps were identified, such as the need for mechanistic studies and clinical trials to fully explore the therapeutic potential of these species. The study also underscores the necessity of sustainable harvesting practices to preserve these valuable resources. This study provides an integrated perspective on the chemical diversity, ethnomedicinal applications, and pharmacological benefits of Philippine *Ficus* species, combining traditional knowledge with modern scientific tools. The findings serve as a foundation for future research and support the sustainable use of *Ficus* species in traditional medicine and drug development.

Keywords: Ficus, Systematic Review, Chemical Constituents, Bioactive compounds, Network Analysis

Introduction

Plants have long been esteemed as a rich source of biologically active pharmacological compounds, a fact supported by extensive research.[1 2 3] Medicinal plants, specifically, harbor a wide variety of metabolites that can treat and cure numerous diseases.[4] These healing properties are typically attributed to secondary metabolites, which vary among different plants.[2 5] As a result, a significant number of modern drugs have been derived from these plant resources. This diversity in chemical composition is key to their effectiveness, highlighting the essential role of plants in the development of contemporary medicine. The intricate process of drug discovery and development spans an average duration of 10 to 15 years before a new medication becomes commercially available.[6] Among the primary stages in this journey is the screening of newly identified plant compounds for their pharmacological potential.[7]

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This method underscores the imperative for institutions like the Institute of Herbal Medicine (IHM) in the Philippines to amass indigenous knowledge, gleaned from folklore, while employing rigorous scientific methodologies to substantiate the claims of traditional healers.

The utilization of medicinal plants steeped in folklore has been deeply interwoven into the tapestry of global history and culture.[8] Across diverse civilizations, herbs and natural elements have served multifaceted roles, promoting health, offering protective qualities, alleviating suffering, and fostering spiritual well-being. These entrenched traditions are particularly pronounced in indigenous communities, including those in the Philippines, and have provided the cornerstone for numerous pharmaceutical breakthroughs by catalysing drug discovery efforts through natural products.[9] Even in contemporary times, natural products retain their pivotal role in advancing human health. They offer a rich reservoir for drug discovery, drawing from varied sources, with countries like the Philippines playing a significant role in their exploration.[10] According to the World Health Organization,[11] in some Asian and African nations, as much as 80% of the populace relies on traditional herbal remedies as their primary form of healthcare, driven by economic and geographical constraints. Their efficacy, diversity, cost-effectiveness, and favourable safety profiles relative to modern synthetic drugs have contributed to their popularity across both developed and developing nations.[12]

The diverse array of medicinal plants found in a country holds more than just traditional healing properties; they also offer potential as sources for discovering new chemical compounds for medicine. The Philippines, one of the world's 18 mega-biodiverse nations, harbours an

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astonishing variety of flora and fauna, encompassing around 70% to 80% of global plant and animal species. With approximately 13 000 plants species, 39% of which is exclusive to its territory making it a rich repository of botanical diversity.[13]

Despite a large history of traditional plant use, scientific exploration of the Philippines' medicinal flora has been largely underutilized until recently, with pharmacological research only beginning to gain momentum. Within the Asia-Pacific region, fourteen countries are actively engaged in researching medicinal plants,[14] including the Philippines. Various institutions such as the Department of Science and Technology-Philippine Council for Health Research and Development, the National Research Council of the Philippines, and prominent academic entities like the University of the Philippines and the University of Santo Tomas, have been instrumental in supporting numerous studies on medicinal plants for several years.[15] In a recent study, it was revealed that among 252 drugs originating from flowering plants, 11 are classified as essential,[16 17] highlighting the substantial impact of this country on phytotherapy and preventive healthcare. This underscores the Philippines' advantageous position for spearheading initiatives in drug discovery.[18]

The genus *Ficus*, the largest in the *Moraceae* family, is also one of the largest plant genera globally, with over 750 species primarily found in tropical regions.[19] It is a vital plant resource with notable economic and nutritional value, contributing to the biodiversity of rainforest ecosystems. The abundance of *Ficus* species in the *Moraceae* family indicates high moisture levels and the presence of shallow aquifers in the watershed.[20] Moreover, *Ficus* is the most common genus in soil seed banks across tropical Asia.[21] The Asian-Australasian region has the richest and most diverse *Ficus* flora,[22] which thrives in lowland tropical rainforests and provides nourishment to many vertebrates.[23]

Species of the genus *Ficus* are commonly known as figs. In the Philippines, figs are found at low and medium altitudes in Luzon, Visayas, and Mindanao.[24 25] Some *Ficus* species and their local names in the Philippines include “Salisi” for *F. benjamina*, the Indian rubber tree for *F. elastica*, “Baleteng-baging” for *F. indica*, “Payapa” for *F. payapa*, “Marabutan” for *F. retusa*, “Botgo” for *F. stipulosa*, “Niog-niogan” for *F. pseudopalma* Blanco, “Tibig” or “Tabog” for *F. nota*, and “Pakiling” or “Is-is” for *Ficus odorata*.[24 25]

Ficus species are renowned for their medicinal uses. The leaves, fruit, bark, roots, and latex of these trees are rich in natural antioxidants, particularly phenolic compounds and flavonoids, which play a crucial role in preventing various health disorders related to oxidative stress, including cardiovascular diseases, neurodegenerative diseases, and cancer.[26] With the growing interest in natural remedies and traditional medicines, the research on *Ficus* species and their pharmacological value holds great significance not only for the Filipino people but also for broader scientific communities and the pharmaceutical industry.

As of the current date, to the best of my knowledge, there exists only a limited amount of reported systematic reviews regarding the chemical constituents and pharmacological effects of fig trees found in the Philippines. Thus, this study aims to:

Provide a Comprehensive Review of Existing Literature
Conduct a systematic review of existing literature on the chemical constituents, ethnobotany, and pharmacological value of *Ficus* species in the Philippines, synthesizing findings to provide a holistic understanding of their potential.

Identify and Catalog Chemical Constituents
Systematically identify and document the chemical compounds present in various *Ficus* species found in the Philippines, including but not limited to the leaves, fruit, bark, roots, and latex.

Document Ethnobotanical Uses
Compile and analyse traditional and contemporary uses of *Ficus* species in the Philippines, focusing on their applications in local medicine.
Assess Pharmacological Properties
Evaluate the pharmacological properties of the chemical constituents found in *Ficus* species, with particular emphasis on their antioxidant, anti-inflammatory, and other bioactive effects.
Provide Insights to the key Bioactive Compounds and its respective Pharmacological Potential
Conduct network analyses using data from the systematic review to explore the connections between *Ficus* species, their chemical constituents, and pharmacological effects which could offer insights into key bioactive compounds and their therapeutic potential.
Identify Gaps in Current Research and Suggest Future Directions:
Identify gaps in the current research on *Ficus* species and suggest future research directions to explore untapped pharmacological potentials and enhance the understanding of their ethnobotanical significance.

Materials and Methods

Scope and delimitation
This research will focus on *Ficus* species found in the Philippines, encompassing regions such as Luzon, Visayas, and Mindanao. It aims to include all known species of the genus *Ficus* indigenous to or commonly found in these areas. The study encompasses literature published between 2010 and 2024 to ensure an up-to-date understanding of recent findings. It will involve identifying and tabulating various chemical constituents present in different parts of the *Ficus* plants, including leaves, fruit, bark, roots, and latex. Additionally, it will document traditional and contemporary uses of *Ficus* species by local communities, highlighting their medicinal applications. The research will assess the pharmacological properties of these chemical constituents, emphasizing their antioxidant, anti-inflammatory, and other bioactive effects while also integrating network analyses to visualize connections between *Ficus* species, bioactive compounds, and their therapeutic potential. Google Scholar will be the primary and only database used for sourcing relevant scholarly articles.

However, the review has several limitations. It is limited to literature available in Google Scholar, which may exclude studies from other databases, potentially introducing publication bias. The study will rely on existing literature, as experimental validation of pharmacological effects is beyond its scope. It will also focus on secondary sources for chemical analysis and compound isolation, with no primary laboratory work included. Additionally, regional variability in ethnobotanical practices and chemical compositions may not be fully captured, and historical or cultural contexts may be under-documented. While the network analysis will help highlight key bioactive compounds and pharmacological effects, integrating traditional knowledge with scientific evidence presents challenges, as ethnobotanical uses may not always align with modern pharmacological data. The accuracy of the network depends on the quality and completeness of the data extracted from the systematic review. Furthermore, the networks are based on available literature and secondary data, meaning that gaps in the literature or unpublished studies could lead to incomplete relationships.

Relevance of Review Methods
The methods employed in this review, including systematic literature review and network analysis, are highly relevant to achieving the study's objectives. The systematic review ensures a thorough and unbiased synthesis of existing research, while network analysis provides a visual and analytical framework to identify key bioactive compounds and their pharmacological effects. These methods collectively enhance the understanding of the therapeutic potential of *Ficus* species and highlight areas for future research.

Novelty/Rationale of the Review
This review provides the first systematic and integrative assessment of the pharmacological potential of *Ficus* species native to the Philippines by combining ethnomedicinal knowledge, phytochemical composition, and experimentally validated bioactivities. Distinct from prior narrative or species-specific reviews, this study applies network analysis to delineate species–compound–bioactivity relationships, enabling the identification of key bioactive hubs, dominant therapeutic targets, and research gaps within Philippine Ficus taxa. By adopting a systems-level

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analytical framework and focusing on literature published between 2010 and 2024, this work addresses a critical geographic and methodological gap, offering robust evidence to support future drug discovery, pharmacological validation, and conservation-oriented research.

Research Design

This study employs a systematic review following the 2020 Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) [27] guidelines to compile and analyse existing literature on the chemical constituents, ethnobotany, and pharmacological value of *Ficus* species found in the Philippines. Data extracted from the systematic review will be organized and visualized through network analyses using the Gephi (Gephi Consortium, version 0.10.1, 2023) [28] to highlight the relationships between *Ficus* species, their bioactive compounds, and pharmacological effects. Google Scholar will serve as the primary database for sourcing relevant publications, focusing on studies published between 2010 and 2024.

Search Strategy

A comprehensive search will be conducted in Google Scholar using specific keywords and phrases related to the research topic as shown in Table 1. The search terms will include "*Ficus*," "Philippines," "ethnobotany," "medicinal," "chemical constituents," "bioactive compounds," "pharmacological," and combinations thereof. Boolean operators (AND, OR) will be used to refine the search results. Additionally, the search will be limited to articles published between 2010 and 2024. Only studies published in English language will be considered.

Table 1: Search Strategy

Database	Search Query	Number of Articles
Google Scholar	("*Ficus*" AND "Philippines") AND ("ethnobotany" OR "medicinal" OR "chemical constituents" OR "bioactive compounds" OR "pharmacological")	4304

Screening and Selection

The results were evaluated through a two-step process. Initially, the titles and abstracts of all identified studies were independently reviewed by the researcher to determine their relevance to the research objectives. Studies that appeared to meet the inclusion criteria based on this initial screening were then subjected to a more thorough review, which involved retrieving and analysing the full-text articles. For each full-text article, a detailed assessment was conducted to confirm eligibility.
Any studies found to be irrelevant or not meeting the inclusion criteria at this stage were excluded from the review. The specific reasons for excluding each of these articles were meticulously documented to maintain transparency in the selection process.
For the studies that passed the full-text screening, comprehensive data extraction was performed. The researcher collected key information from each study, including the name of the first author, the year of publication, the specific *Ficus* species under investigation, ethnobotanical information related to traditional uses and cultural significance, the bioactive compounds identified in the plants, and their documented medicinal applications. This extracted data served as the foundation for the subsequent analysis and synthesis of findings in the systematic review.

Inclusion and Exclusion Criteria

Inclusion Criteria

Articles published in scholarly journals between 2010 and 2024.
Studies focusing on *Ficus* species found in the Philippines.
Papers that discuss the chemical constituents, ethnobotanical uses, or pharmacological properties of *Ficus* species.
Publications in English or with a comprehensive English abstract.

Free access articles

Exclusion Criteria

Articles not related to *Ficus* species in the Philippines.
Non-scholarly publications, such as news articles or opinion pieces.
Studies lacking sufficient data on chemical constituents, ethnobotany, or pharmacological properties of *Ficus* species found in the Philippines.
Duplicate studies.
Studies not in English language.

Data Extraction

The articles selected for analysis will have their data systematically extracted using a standardized approach and will be recorded in Microsoft Word (Microsoft Corporation, Microsoft 365, 2023) [29] for documentation. The extracted data will include:
Publication details: Author(s), year of publication, journal name.
Species information: Specific *Ficus* species studied.
Chemical constituents: Identified compounds in various parts of the plant (leaves, fruit, bark, roots, sap, etc.).
Ethnobotanical uses: Traditional and contemporary uses by local communities in the Philippines.
Pharmacological properties: Documented pharmacological effects and related health benefits.
In addition, the extracted data will be organized to facilitate the construction of the network analysis. The data will be structured to clearly link *Ficus* species to its bioactive compounds and their pharmacological effects. These relationships will serve as the foundation for creating a network model, where each *Ficus* species will be linked to the chemical constituents identified and to its proven therapeutic effect (e.g., antioxidant, anti-inflammatory, etc.).

Data Synthesis

The gathered data will be organized into a table to offer a detailed summary of the chemical components, ethnobotanical applications, and pharmacological characteristics of *Ficus* species in the Philippines. The synthesis will involve:
Summarizing the identified chemical compounds and their distribution across different species.
Documenting and categorizing the ethnobotanical uses of *Ficus* species.
Evaluating the pharmacological properties and potential health benefits based on the reported bioactive compounds.

Statistical and Network Analysis

Data extracted from the included studies were synthesized using descriptive and network-based analytical approaches. Descriptive statistics were employed to summarize the distribution and frequency of *Ficus* species, plant parts used, bioactive compounds, and reported pharmacological activities. Results are presented as counts and proportions to provide an overview of prevailing research trends and therapeutic profiles.
To further elucidate the complex relationships among *Ficus* species, chemical constituents, and pharmacological effects, network analysis was performed using Gephi version 0.10.1. Two bipartite networks were constructed: (i) a species–compound network linking *Ficus* species to their identified bioactive compounds, and (ii) a species–bioactivity network connecting *Ficus* species to experimentally validated pharmacological activities. In each network, nodes represent species, compounds, or pharmacological effects, while edges indicate documented associations extracted from the systematic review.
Network structure was quantitatively characterized using network-level and node-level metrics, including network density, average degree, and degree centrality. Network density was calculated to assess overall network connectivity, average degree to describe the mean number of

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associations per node, and degree centrality to identify highly connected species, compounds, and pharmacological activities that may represent key therapeutic hubs. All analyses were descriptive in nature, and no inferential statistical testing or meta-analysis was conducted.

Results and Discussion

During the initial search, a total of 4,304 prospective studies were identified from the Google Scholar database. The screening process began with the removal of 1,338 duplicate records, which were found to be redundant entries within the dataset. Following this, a further 2,429 studies were excluded after a thorough review revealed they were not pertinent to the focus of the research. Additionally, 96 papers were deemed inaccessible, likely due to restrictions on availability or issues with retrieval. Furthermore, an additional 337 studies were excluded as they did not align with the predetermined inclusion criteria, which were established to ensure the relevance and quality of the selected studies. After these stages of refinement, we successfully gathered a final set of 104 unique and relevant papers that met all the criteria necessary for inclusion in our study. This curated collection represents the most pertinent research available for the analysis (Figure 1).

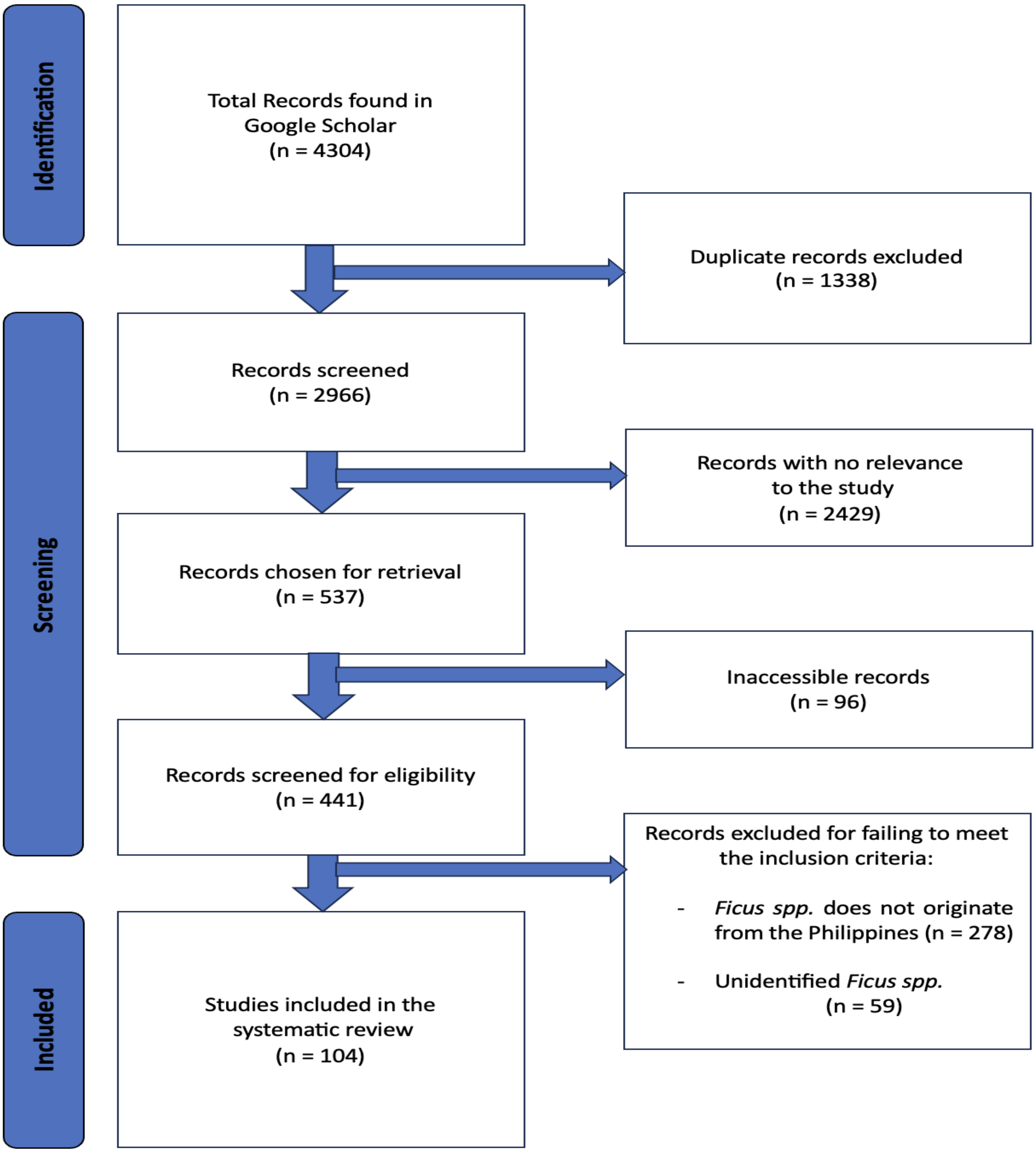

Figure 1: Visual representation following PRISMA guidelines.

Ethnobotany

The use of medicinal plants, particularly those of the *Ficus* genus, has been a longstanding practice in traditional medicine across different cultures. *Ficus* is a genus known for its extensive use in treating various diseases and health conditions due to its numerous active constituents. A total of 38 plants were identified in this systematic review but only 28 of them have their own respective ethnobotany. Of these, the most noteworthy plants with the broadest range of application are *Ficus*

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septica, Ficus pseudopalma, Ficus nota, Ficus minahassae, and Ficus benjamina.

Ficus septica has been traditionally employed for its antimicrobial, antibacterial, and antifungal properties. Vital et. al.[30] conducted a study demonstrating that the leaves of this plant possess remarkable antimicrobial, antibacterial, and antifungal activities. These effects can be attributed to the presence of several key compounds, including alkaloids, quaternary bases, tannins, 2-deoxysugars, and a benzopyrone nucleus. These bioactive constituents contribute to the plant's potent antimicrobial capabilities. Given these findings, *F. septica* shows considerable promise as a potential alternative source for developing new antimicrobial agents.

The leaves of *Ficus pseudopalma* are believed to have anti-diabetic properties and are commonly prepared by boiling the leaves to create a decoction, which is then consumed orally.[31] Research by Salonga et al.[32] further supports this notion, as their study demonstrated that the extract from *F. pseudopalma's* leaves has a notable effect in suppressing blood glucose levels. This suggests that the plant's extract could be a promising candidate for managing and controlling blood sugar levels. The combined evidence from traditional use and scientific research highlights the potential of *F. pseudopalma* as a beneficial natural remedy for diabetes management.

Ficus nota has been conventionally utilized for treating a variety of health issues, including urinary tract infections (UTIs), hypertension, and diabetes. In a comprehensive study by Franco et al.,[33] the ethanolic crude extract of *F. nota* leaves were analysed and found to contain several important bioactive compounds, such as carbohydrates, flavonoids, saponins, tannins, and glycosides. These compounds are collectively responsible for the plant's therapeutic effects. Specifically, they work by inhibiting alpha-glucosidase, an enzyme that plays a critical role in carbohydrate digestion and glucose absorption. This inhibition contributes to the plant's anti-hyperglycemic properties, making it beneficial for managing blood sugar levels.

Ficus minahassae is widely regarded for its extensive health benefits and is commonly used in traditional medicine to treat a wide range of diseases. This includes easing muscle pain, alleviating fatigue, managing rheumatism, reducing fever, and relieving headaches. Furthermore, the presence of β-sitosterol and phytyl fatty acid esters in the plant highlights its potential as a candidate for anti-SARS-CoV-2 drug development. β-sitosterol is known for its strong affinity for the receptor-binding domain, which could play a crucial role in inhibiting viral entry. Meanwhile, phytyl fatty acid esters demonstrate a significant affinity for the spike glycoprotein in its closed state, potentially interfering with the virus's ability to bind and infect host cells.[34]

Ficus benjamina is known for its diverse therapeutic applications, including its use in treating bone fractures, alleviating joint pain, addressing skin conditions, reducing fever, and combating infections. In a comprehensive study conducted by Imran et al.,[35] it was discovered that both the roots and stems of *F. benjamina* exhibit significant antimicrobial activity. Additionally, these plant parts are notably rich in antioxidants, which contribute to their therapeutic effects. The study highlighted that the roots of *F. benjamina* are particularly abundant in several phenolic compounds, such as chlorogenic acid, p-coumaric acid, ferulic acid, and syringic acid. These compounds play a crucial role in the plant's ability to fight infections and neutralize harmful free radicals. Similarly, the stems contain chlorogenic acid, p-Coumaric acid, and ferulic acid, which are also associated with substantial haemolytic activity. This haemolytic activity indicates the plant's potential effectiveness in breaking down red blood cells, which can be relevant in various medicinal contexts.

Chemical Constituents and Its Pharmacological Effects

Extensive research into the phytochemical composition of the *Ficus* genus has led to the discovery of a vast array of bioactive compounds, each offering a unique potential for therapeutic application. Through a meticulous process of extraction, isolation, and characterization, scientists have been able to delve into the intricate chemical makeup of these plants, revealing an impressive spectrum of biological activities that could pave the way for new treatments and remedies. These findings, as outlined in Table 2, underscore the genus's profusion in compounds that contribute to a wide range of health benefits.

Table 2: *Ficus* species in the Philippines with their corresponding ethnobotany, bioactive compounds, and pharmacological effects.

List of Species	Plant part used	Claimed disease/ailments treated	Chemical Constituents	Pharmacological Effects
Ficus nota	Fruit (46)(132)(139)(90)	Fever, muscle pain, urinary tract infections, hypertension, diabetes (83), toothache, stomach ache (90)	4-(2-hydroxyethyl)- 2-methoxyphenol, meso-2,3-butanediol, (2R,3R)-2,3-butanediol, (2S,3S)-2,3-butanediol, β-sitosterol (46), alkaloids, tannins, flavonoids, saponins, flavonoids, anthraquinones (132)	
	Leaf (69)(33)(31)(98)(117)(125)(132)(136)(139)	Sprain (31), backache (125), antifungal, antimicrobial (136)	Alkaloids, flavonoids, phenols, terpenoids, saponins, tannins (69), diarylbutanoids (98)	Antioxidant, pro-oxidant, treatment and prevention of cardiovascular disease, diabetes, cancer, aging (69), antidiabetic, anti-hyperglycemic (33), antidiabetic, anti-hyperglycemic (33), antibacterial (98), antibacterial, antifungal, potential cytotoxic properties (117), antibacterial (132)

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	Root (49)(58)(127)(132)(142)	Fever, headache, stomach ache (49), post-partum recovery, milk production, headache (58), headache, galactagogue (132), postpartum care and recovery, milk production enhancer, spasm (142)		
	Stem (58)(80)(99)(139)	Repellent (80), headache, neonatal care uses (99), UTI (139)		
	Bark (127)	Enhance breast milk production (127)		
	Seed (133)		Linoleic acid, linolenic acid, terpenoids, triterpenes (133)	
Ficus minahassae	Leaf (47, 45, 120)	Improve milk production of lactating mothers, relief for muscle pain & fatigue, heals bruises (45), rheumatism (121),	Phenols (47), *β*-sitosterol, phytyl fatty acid esters (120)	Antioxidant (47), potential *anti-SARS-CoV-2* drugs (120)
	Root (45, 50, 81, 139)	Fever, headache (50), bone fracture, rheumatism, promote lactation, astringent, antibacterial (81), relapse, fracture (139)	Alkaloids, anthraquinones, steroids, triterpenoids (81)	
	Stem (80)	Repellent (78)		
	Fruit (92)	Childbirth (90)	Steroids, flavonoids, saponins, tannins, polyphenols (92)	Antioxidant (92)
	Bark (132)	Loose bowel movement, ulcer (132)		
	Shoot (141)	Convulsion, colds, cough, fever, influenza (141)		
Ficus septica / Ficus hauili	Leaf (44, 48, 51, 58, 68, 70, 78, 79, 81, 82, 84, 87, 95, 97, 104, 107, 108, 114, 122, 125, 127, 128, 129,	Anti-microbial, antifungal (70), antirheumatic (44), relapse, stroke (51), fever, headache (70), sudden cough, abdominal pain, swellings (58), dizziness, fever (70), flu, rheumatoid (70) arthritis, muscle swelling (68),	β-sitosteryl-3β-glucopyranoside-6'-O-fatty acid esters, α-amyrin fatty acid esters, β-sitosterol and stigmasterol, β-amyrin, long chain of saturated fatty alcohols (45), alkaloids, glycosides,	Anticancer (adenocarcinoma and melanoma), analgesic properties, anti-inflammatory (48), anti-dengue infection (70), anticancer (81), anticancer

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130, 134, 135, 30, 139, 142, 70)	cold, cough, antibacterial (70), stomach ache (78), warts (79), rheumatism, diuretic (81), headache, stomach ache, warts (82), headache (83), stomach trouble, asthma, sinusitis, muscle pain, backache, body ache, headache, fever, weakness, fatigue, warts, cataract, eye problem, herpes simplex, boils, eye problem (84), wounds (90), fever (95), physical relapse, stroke (97), headache, rheumatism (104), headache (107), diarrhea, cough, and stomach problems, diuretic, boils, headache, rheumatism (108), fever, herpes simplex, muscle pain, skin problem, stomach trouble, weakness and fatigue (114), overfatigue (119), urinary problems (121), fever, headache, cut and wounds (122), cancerous tumors (125), appendicitis, snake bite, spasm, rashes, warts, skin allergy, headache (126), headache (127), asthma, body pain, cataract, fatigue, fever, herpes simplex, muscle pain, skin diseases and infections, stomach trouble, warts (128), facilitate labor and delivery, snake bite, diarrhea, flu, headache, toothache, himugnaw (129), headache (130), relief sickness felt after missing a meal or “pasmo”, relief of muscle pain or over fatigue or “bughat” in women (134), bruises (135), headache, fever, flatulence, stroke, thiamine deficiency, cough, muscle pain, relapse, ulcer (139), fever (142)	tannins (81) β-Sitosteryl-3α-glucopyranoside-6'-O-palmitate (104), sterols, flavonoids, alkaloids, glycosides, tannins (125), alkaloids, tannins, 2-deoxysugars, benzopyrone nucleus (30)	(87), cytotoxic, analgesic (97), antimicrobial (32)
Root (50)(72)(77)(84)(108)(114)(128)(132)(134)(139)	Cough (72), headache, fever (77), stomach trouble, asthma, sinusitis, muscle pain, backache, body ache, headache, fever, weakness, fatigue, warts, cataract, eye problem, herpes simplex, boils, eye problem (84), diarrhea, cough, and stomach problems, diuretic, boils, headache, rheumatism (108), asthma, body pain, cataract, fatigue, fever, herpes simplex, muscle pain, skin diseases and infections, stomach trouble, warts (128), relief sickness felt after missing a meal or “pasmo”, relief of muscle pain or over fatigue or “bughat” in women (134), headache, fever, flatulence, stroke, air wave, thiamine deficiency, cough, muscle pain, relapse, ulcer (139)		

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Fruit (70)(82)	Anti-microbial, antifungal (70), headache, stomach ache, warts (82)		Anti-dengue infection (70)
Stem (70)(77)(84)	Anti-microbial, antifungal (70), headache, fever (77), stomach trouble, asthma, sinusitis, muscle pain, backache, body ache, headache, fever, weakness, fatigue, warts, cataract, eye problem, herpes simplex, boils, eye problem (84)		Anti-dengue infection (70)
Heartwood (70)	Anti-microbial, antifungal (70)		Anti-dengue infection (70)
Young shoot (82)(130)	Headache, stomach ache, warts (82), headache (130)		
Sap (84)(122)	Stomach trouble, asthma, sinusitis, muscle pain, backache, body ache, headache, fever, weakness, fatigue, warts, cataract, eye problem, herpes simplex, boils, eye problem (83), fever, headache, cut and wounds (122)		
Sprout (110)	Headache (110)		
Branch (129)	Facilitate labor and delivery, snake bite, diarrhea, flu, headache, toothache, himugnaw (129)		
Bark (132)(133)	Diarrhea, infectious diseases (66), post-partum, joint problems (132)		Antimitotic, antiproliferative (133)
Seed (133)		Linoleic acid, linolenic acid, terpenoids, triterpenes (133)	

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	Whole plant (139)	Headache, fever, flatulence, stroke, air wave, thiamine deficiency, cough, muscle pain, relapse, ulcer (139)	Very high content of Tannins, high content of Alkaloids, Anthraquinones, Flavonoids, & Steroids, & with small amount of Saponins (123)	
Ficus benjamina / *Ficus nuda*	Root (45, 51, 76, 97, 108, 127, 129, 132, 142)	Relief for muscle pain & fatigue, appetite stimulant (45), broken bones (51), muscle spasm (90), broken bones (97), postpartum care and recovery, stomach ache (105), wounds, bruises, rheumatism, relief muscle pain, fatigue (108), wounds, bruises (121), fatigue, buyag (126), hair growth, fracture (127), fractured bone, joint pain (129), fractures, joint problems (132), hair growth enhancer, spasm (141)	2-pentanone, hexadecanoic acid, palmitic acid, 9,12-octadecadienoic acid, methanamine, cyclopentanone, methyl-2 phenylindole, cyclopropaneoctanal, arsenous acid, hexadecanoic acid, palmitic acid and 9,12-octadecadienoic acid, chlorogenic acid, paracoumaric acid, ferulic acid, syringic acid, caffeic acid, ursolic, α-hydroxy ursolic, protocatechuic, and maslinic acids (76), phenolic compounds (97)	Antioxidant, antimicrobial (76), antimicrobial, antioxidant (97)
	Leaf (66)(76)(93)(108)(124)	Skin ailments, infections, intestinal illnesses, retching, antimicrobial, antipyretic, antinociceptive (66), wounds, bruises, rheumatism, relief muscle pain, fatigue (108)	Cinnamic acids, lactose, naringenin, quercetin, caffeic acid, stigmasterol, alpha-Pinene, abietadiene, cis-alpha-bisabolene, gas, reticuline, calycanthidine, anabasine, tomatidine, acridine derivative, sophocarpine, neblinine, harmine, obscurinervinediol, ergoline, ellipticine, indicine, matridine, scoulerine, hydroxyl morphine, aspidospermidin, nicodicodine, adenocarpine, lycocernuine, isoclaurine, dasycarpidan, retronecine, clemastine, methanamine, cyclopentanone, methyl-2 phenylindole, cyclopropaneoctanal (64), 2-pentanone, hexadecanoic acid, palmitic acid, 9,12-octadecadienoic acid, methanamine, cyclopentanone, methyl-2 phenylindole, cyclopropaneoctanal, arsenous acid, hex- adecanoic acid, palmitic acid and 9,12-octadecadienoic acid, chlorogenic acid, paracoumaric acid, ferulic acid, syringic acid, caffeic acid, ursolic, α-hydroxy ursolic, protocatechuic, and maslinic acids (76), triterpenoids, flavonoids, phenolic compounds (124)	Antibacterial, antioxidant, antifungal activity, insect repellent, anthelmintic activity (66), antioxidant, antimicrobial (76), antioxidant (93), antioxidant, anti-tumor (124)

	Bark (66)(77)(85)(108)(124)(127)(129)(132)	Fracture (77), rheumatism (85), wounds, bruises, rheumatism, relief muscle pain, fatigue (108), hair growth, fracture (127), fractured bone, joint pain (129), fractures, joint problems (132)	Cinnamic acids, lactose, naringenin, quercetin, caffeic acid, stigmasterol, alpha-Pinene, abietadiene, cis-alpha-bisabolene, gas, reticuline, calycanthidine, anabasine, tomatidine, acridine derivative, sophocarpine, neblinine, harmine, obscurinervinediol, ergoline, ellipticine, indicine, matridine, scoulerine, hydroxyl morphine, aspidospermidin, nicodicodine, adenocarpine, lycocernuine, isoclaurine, dasycarpidan, retronecine, clemastine, methanamine, cyclopentanone, methyl-2 phenylindole, cyclopropaneoctanal (66), triterpenoids, flavonoids, phenolic compounds (124)	Antibacterial, antioxidant, antifungal activity, insect repellent, anthelmintic activity (66), antioxidant, anti-tumor (124)
	Stem (66)(76)(132)	Fractures, joint problems (132)	Cinnamic acids, lactose, naringenin, quercetin, caffeic acid, stigmasterol, alpha-Pinene, abietadiene, cis-alpha-bisabolene, gas, reticuline, calycanthidine, anabasine, tomatidine, acridine derivative, sophocarpine, neblinine, harmine, obscurinervinediol, ergoline, ellipticine, indicine, matridine, scoulerine, hydroxyl morphine, aspidospermidin, nicodicodine, adenocarpine, lycocernuine, isoclaurine, dasycarpidan, retronecine, clemastine, methanamine, cyclopentanone, methyl-2 phenylindole, cyclopropaneoctanal (66), 2-pentanone, hexadecanoic acid, palmitic acid, 9,12-octadecadienoic acid, methanamine, cyclopentanone, methyl-2 phenylindole, cyclopropaneoctanal, arsenous acid, hex- adecanoic acid, palmitic acid and 9,12-octadecadienoic acid, chlorogenic acid, paracoumaric acid, ferulic acid, syringic acid, caffeic acid, ursolic, α-hydroxy ursolic, protocatechuic, and maslinic acids (76)	Antibacterial, antioxidant, antifungal activity, insect repellent, anthelmintic activity (66), antioxidant, antimicrobial (76)
	Sap (33)	Sprain (33)		
	Trunk (103)	Sprain (103)		
	Fruit (124)		Triterpenoids, flavonoids, phenolic compounds (124)	Antioxidant, anti-tumor (124)
Ficus gul	Bark (45)	Enhance milk production in women after giving birth (45)		

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Ficus linearifolia	Bark (50)	Warts, headache, fever (50)		
	Leaf (56)		β-amyrin, α-amyrin, squalene, β-sitosterol, β-stigmasterol, polyprenol, linoleic acid, lutein, triterpenes (56)	
Ficus simplicissima	Root (50)	Diarrhea (50)		
Ficus elastica	Leaf (52)(116)(97)	Cough, rashes, cancer (51), sprain, body pain, headache (116), trichuriasis, wounds (121), dermatological diseases (65), cough, rashes, cancer (97)	Flavonoids (97)	Antitumor, antioxidant, cytotoxic (97)
	Root (51)	Cough, rashes, cancer (51)		
	Bark (116)(96)	Sprain, body pain, headache (116)	Alkaloids, flavonoids, phenolics, Saponins, Glycosides, terpenoids, eugenols (96)	Antimalarial (96)
	Root (58)(97)	Urination difficulty, arthritis, muscle pain (58)	Flavonoids (97)	Antitumor, antioxidant, cytotoxic (97)
Ficus pumila	Root (51)(97)	Impotence, menstrual discorders (51), impotence, menstrual disorders (97), dysentery, hematuria (121)		
	Fruit (140)		Arabinogalactan (140)	Immunomodulatory (140)
Ficus pseudopalma	Leaf (52)(54)(58)(60)(61)(62)(68)(31)(80)(84)(100)(109)(112)(114)(127)(128)(134)	Hyperglycemia, kidney stones (53), post-partum recovery, post-partum care, headache (58), diabetes, kidney stone, UTI, stomach ulcer (68), hypertension (31), repellent (80), diabetes, hypertension, atherosclerosis, hemorrhage, diarrhea, stomach trouble, dyspepsia, kidney stones, muscle pain, postpartum care and recovery, cramps, spasms (84), cramp and spasm, diarrhea, hemorrhage, muscle pain, cataract (114), seizure (126), headache, relapse (127), diabetes, hemorrhage, hypertension, kidney problem, postpartum care and recovery, spasm, stomach trouble (128), kidney failure (134)	Phenols, flavonoids (52), Lupeol (54), quercetin, lupeol (60), squalene, polyprenol, β-amyrin fatty acid ester, α-amyrin acetate, β-amyrin acetate, lupeol fatty acid ester, lupenone, oleanone, ursenone (61), α-amyrin, oleanolic acid, ursolic acid (109)	Antioxidant (52)(54)(60), anticancer (hepatocellular carcinoma) (52)(63), cardioprotection (54), hepatoprotection, anticancer (54), hepatoprotective (60), antibacterial (61), hepatoprotective (100), antioxidant (109), antioxidant, antiurolithiatic (112)

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	Stem (58)(80)(99)(127)	Post-partum recovery, post-partum care, headache (58), repellent (80), headache, postpartum wash (99), headache, relapse (127)		
	Root (84)(114)(125)(128)(142)	Diabetes, hypertension, atherosclerosis, hemorrhage, diarrhea, stomach trouble, dyspepsia, kidney stones, muscle pain, postpartum care and recovery, cramps, spasms (84), cramp and spasm, diarrhea, hemorrhage, muscle pain cataract (114), diabetes, hemorrhage, hypertension, kidney problem, postpartum care and recovery, spasm, stomach trouble (128), cough, tuberculosis, spasm (142)		
	Fruit (91)		Phenolics, flavonoids, tannins, cardiac glycosides, saponins (91)	Antioxidant, antibacterial (91)
	Bark (125)(137)	Diabetes (125), convulsion (137)		
Ficus odorata	Leaf (55)(63)(111)(138)		β-sitosteryl-3β-glucopyranoside-6'-*O*-palmitate, squalene, lutein, α-amyrin acetate, lupeol acetate, β-carotene (55), terpenes, glycosides, phenolic acids (61), phenols, flavonoids, terpenoids, alkaloids, tannins, β- cyanins, coumarins (138)	Anticancer (human stomach adenocarcinoma) (55), pro-oxidant (anticancer application) (63), hypoglycemic, antioxidant (111), anticancer, antioxidant (138)
Ficus triangularis	Leaf (56)		Squalene, β-sitosterol, β-stigmasterol, polyprenol, linoleic acid, lutein, sterols triterpenes (56)	
	Stem (59)		3,5,4'-trihydroxy-6",6"-dimethylpyrano [2",3":7,6] flavanone, α-amyrin fatty acid ester, β-amyrin fatty acid ester, lupeol fatty acid ester, stigmast-4-en-3-one, β-sitosterol, stigmasterol (59)	

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Ficus ampelos	Twig (57)(102)		Ursolic acid, oleanolic acid, butyrospermol cinnamate, lutein (57), squalene, β-amyrin fatty acid esters, α-amyrin fatty acid esters, β-sitosterol, stigmasterol, saturated fatty acids, β-sitosteryl-3β-glucopyranoside-6β-*O*-fatty acid esters, long-chain fatty alcohols (102)	Anti-inflammatory, anti-tumor, chemopreventive properties (57)
	Leaf (57)		Ursolic acid, oleanolic acid, butyrospermol cinnamate, lutein (57)	Anti-inflammatory, anti-tumor, chemopreventive properties (57)
	Fruit (102)		Squalene, β-amyrin fatty acid esters, α-amyrin fatty acid esters, β-sitosterol, stigmasterol, saturated fatty acids, β-sitosteryl-3β-glucopyranoside-6β-*O*-fatty acid esters, long-chain fatty alcohols (102)	
Ficus nervosa	Leaf (64)		Lupenone, β-friedelinol, squalene, β-sitosterol, cycloeucalenol, lupeol, α-amyrin, β-amyrin (64)	
Ficus casiguranensis	Leaf (65)			Antibacterial, mosquito larvicidal (65)
Ficus camarinensis	Leaf (65)			Antibacterial, mosquito larvicidal (65)
Ficus deltoidea	Leaf (71)(86)(88)(89)(94)(101)(106)(118)(136)	Itchiness, diarrhoea, cancer, sexual dysfunction, age-related issues, malaria, cancer, anxiety, pain, constipation, fever, diabetes, tooth pain, tooth decay (106)	Flavonoid, tannins, terpenoids, phenol, proanthocyanins, lignans, alkaloids, courmarins, vitexin, isovitexin (85), β-Caryophyllene, 1-epi-cubenol, hexadecanoic acid, phytol, -elemene, α-humulene, (E, E)-α-farnesene and δ-cadinene (94), phenols, flavonoids (136)	Antiviral (Mosquito-Borne Chikungunya Virus) (71), cytotoxicity against leukemia cell lines (86), antioxidant, antidiabetic (88), anti-oral ulcer (89), anticancer (prostate cancer) (101), anticancer, antioxidant, anti-inflammatory, antimicrobial, antihypertensive, aphrodisiac, wound healing (106), antiangiongenic (118), antioxidant (136)
Ficus benguetensis / Ficus fistulosa	Seeds (33)	Insect bites (33)		
	Bark (84)(114)(128)	Colds, diabetes, hypertension, asthma, cough, respiratory disease complex, diarrhea, stomachache, urinary tract infection, maternal care, postpartum recovery, milk production enhancer, weakness and fatigue, relapse, body ache, headache, fever (84), respiratory diseases complex, stomach trouble, weakness and fatigue, atherosclerosis (114), asthma,		

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		colds, cough, diabetes, fatigue, hypertension, postpartum care and recovery, respiratory problem (128)		
	Root (84)(114)(128)	Colds, diabetes, hypertension, asthma, cough, respiratory disease complex, diarrhea, stomachache, urinary tract infection, maternal care, postpartum recovery, milk production enhancer, weakness and fatigue, relapse, body ache, headache, fever (84), respiratory diseases complex, stomach trouble, weakness and fatigue, atherosclerosis (114), asthma, colds, cough, diabetes, fatigue, hypertension, postpartum care and recovery, respiratory problem (128)		
	Fruit (84)	Colds, diabetes, hypertension, asthma, cough, respiratory disease complex, diarrhea, stomachache, urinary tract infection, maternal care, postpartum recovery, milk production enhancer, weakness and fatigue, relapse, body ache, headache, fever (84)		
	Leaf (84)	Colds, diabetes, hypertension, asthma, cough, respiratory disease complex, diarrhea, stomachache, urinary tract infection, maternal care, postpartum recovery, milk production enhancer, weakness and fatigue, relapse, body ache, headache, fever (84)		
Ficus fiskei	Leaf (75)		Alkaloids, saponins, flavonoids, tannins, phenolics (75)	Antioxidant, pro-oxidant (75)
Ficus stricta	Bark (79)	Fracture (79)		
Ficus ulmifolia	Leaf (80)	Repellent (80) colds, dewormer (83)		
	Fruit (91)		Phenolics, flavonoids, tannins, saponins (91)	Antioxidant (91)
	Seed (133)		Linoleic acid, linolenic acid, terpenoids, ulmifolia (133)	
Ficus heteropleura	Bark (82)	Fracture, dislocation (82)		
Ficus variegata	Sap (82)	Toothache (82), boils, dysentery (121)		

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Ficus botryocarpa	Root (84)(114)	Headache, fever (84), fever, headache Asthma, diabetes, postpartum care and recovery (114)
	Trunk (103)	Anticancer (103)
	Stem (141)	Body and muscle pain (141)
Ficus cassidyana	Bark (84)(114)	Colds, diabetes, hypertension, asthma, cough, respiratory disease complex, diarrhea, stomachache, urinary tract infection, postpartum recovery, maternal care, milk production enhancer, weakness and fatigue, relapse, diabetes, body ache, headache, fever (84), respiratory disease complex, stomach trouble, weakness and fatigue (114)
	Root (84)(114)	Colds, diabetes, hypertension, asthma, cough, respiratory disease complex, diarrhea, stomachache, urinary tract infection, postpartum recovery, maternal care, milk production enhancer, weakness and fatigue, relapse, diabetes, body ache, headache, fever (84), respiratory disease complex, stomach trouble, weakness and fatigue (114)
	Fruit (84)	Colds, diabetes, hypertension, asthma, cough, respiratory disease complex, diarrhea, stomachache, urinary tract infection, postpartum recovery, maternal care, milk production enhancer, weakness and fatigue, relapse, diabetes, body ache, headache, fever (84)
	Leaf (84)	Colds, diabetes, hypertension, asthma, cough, respiratory disease complex, diarrhea, stomachache, urinary tract infection, postpartum recovery, maternal care, milk production enhancer, weakness and fatigue, relapse, diabetes, body ache, headache, fever (84)

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Ficus concinna	Bark (84)(114)(128)(131)(141), leaf (84)(114)(128), root (84)(114)(128)(131)	Prostate cancer, cyst, tumor, arthritis, rheumatism, kidney problem, prostate problem, cuts and wounds, fracture, dislocation, sprain (84), Arthritis, cancer, cuts and wounds, fracture and dislocation Diabetes, hypertension (114), cuts, wounds (131), broken bones (141)		
Ficus cumingii	Fruit (92)	Alkaloids, steroids, flavonoids, saponins, polyphenols (92), arthritis, cancer, cyst, fracture and dislocation, kidney and prostate problems, tumour, wounds (128)		Antioxidant (92)
Ficus heteropoda	Trunk (97)(103)	Tuberculosis, antibiotic after bleeding (97)(103)		
Ficus virens	Stem bark (113)	Apoplexy, blood diseases, bone fracture, delirium, diabetes, leucorrhoea, pain, rheumatism, skin ulcers, vertigo, gargle in salivation (113)	6-α-D- tetraglucoside (113)	
Ficus infectoria				Hypoglycaemic, antihyperlipidemic activity (115)
Ficus glomerata	Fruit (115)			Lipid-lowering effect (115)
Ficus carica	Leaf (118)			Antiangiogenic (118)
Ficus stipulosa		Sprain (119), wounds (121)		

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Ficus indica		Wounds, urinary problems (121)
Ficus payapa		Wounds (121)
Ficus retusa		Rheumatism, flatulent colic (121)
Ficus balete	Bark (125)(136)(139)	Fracture (125)(136)(139)
	Stem (139)	Fracture, sore (139)
Ficus congesta		Viral infection, wound, haemorrhoids, rashes, boils, breast cancer (126)

Among the beneficial properties identified are anti-hypertensive effects, which can help in the management of high blood pressure, and anti-diabetic properties that may assist in regulating blood sugar levels. Additionally, the genus exhibits potent anti-fungal activity, providing a natural means to combat fungal infections, and antiurolithiatic properties, which can be beneficial in preventing the formation of kidney stones. The antihyperlipidemic effects are noteworthy for their potential to lower cholesterol levels, while the antiviral and anti-dengue activities highlight the genus's capability to fight off viral infections.
Further, the insect repellent properties of certain *Ficus* species offer an eco-friendly alternative to chemical repellents, and the anti-angiogenic effects demonstrate potential in inhibiting the growth of new blood vessels, which is crucial in cancer treatment. The anti-tumour and anti-cancer properties observed in some species of the *Ficus* genus indicate their possible role in combating various forms of cancer. Additionally, the genus is rich in compounds with anti-inflammatory, anti-microbial, antioxidant, and hepatoprotective effects, which collectively contribute to reducing inflammation, fighting infections, neutralizing harmful free radicals, and protecting the liver from damage, respectively. The analgesic properties also add to the genus's therapeutic profile, offering pain relief in various conditions.
Among the various species within the *Ficus* genus, *Ficus deltoidea* stands out as having the most extensive range of documented pharmacological effects, with a total of 11 distinct therapeutic properties identified. This places it as the most pharmacologically versatile species studied within this genus. Next is, *Ficus nota* and *Ficus septica*, each demonstrating 8 distinct pharmacological activities, placing them among the more therapeutically promising species within the genus. Following closely behind is *Ficus pseudopalma*, which has been found to possess 6 different bioactive effects, underscoring its significant medicinal potential. After *Ficus pseudopalma* is *Ficus benjamina*, having 5 proven bioactivities. Lastly, *Ficus elastica*, while slightly less diverse in its range of documented effects, still exhibits a substantial profile with 4 identified pharmacological properties.

Utilized Plant Parts
Based on the comprehensive analysis of the data presented in Figure 2, it was found that 14 different parts of plants were employed in the various studies that were selected. Among these, the leaves emerged as the most commonly used part, making up 40.09% of the total plant parts utilized. This dominance of leaves underscores their importance in both traditional and contemporary medicine, which is likely due to their high concentration of beneficial compounds, ease of collection, relative abundance, and the sustainability of their continued harvest. Roots were the second most frequently used plant part, accounting for 21.55%, while bark ranked third, comprising 14.22% of the total usage. In addition to these commonly used parts, the studies also explored the medicinal potential of other plant components such as the stem, which often supports a wide array of bioactive compounds; the fruit and seed, which are known for their potent therapeutic properties; and the sap, which may contain healing and protective substances. The analysis also highlighted the use of parts like the trunk, shoot, twig, heartwood, sprout, branch, and even the entire plant, each contributing its own unique set of medicinal properties. This comprehensive use of various plant parts reflects the diverse ways in which different components of plants can be harnessed for their therapeutic potential, providing a rich source of natural remedies that can address a wide range of health conditions.

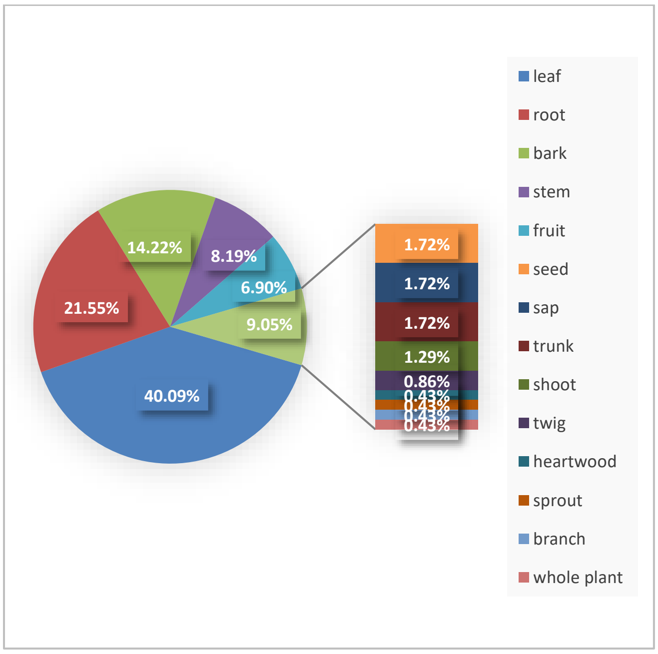

Figure 2: *Ficus spp.* parts utilized

The prevalent use of leaves in various applications can be attributed to several key factors, including their ease of collection, their relative abundance, and the sustainability of harvesting them over time. The ease with which leaves can be collected is largely due to their conspicuous location on the plant, which makes them readily accessible for harvest. Unlike other plant parts that might require specialized tools

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or techniques for extraction, leaves can be gathered without the need for such equipment or expertise, making the process straightforward and efficient.

In addition to their accessibility, leaves are relatively abundant, which contributes to their desirability for use in medicinal and other applications. The high availability of leaves allows for the collection of large quantities with relative ease, further enhancing their appeal. This abundance not only facilitates the gathering process but also ensures that there is a steady supply of leaves for use in various preparations.

Another important factor is the sustainability of harvesting leaves. Unlike parts of the plant that may be more crucial for the plant's overall health and survival, such as roots or stems, leaves can be collected with minimal impact on the plant's long-term viability. Harvesting leaves does not typically cause significant damage to the plant or threaten its survival, allowing for periodic and repeated collection without leading to severe impairment or premature death of the plant. This characteristic makes the harvesting of leaves a sustainable practice, ensuring that plants can continue to thrive while still providing a regular supply of leaves for use.[4]

Network Analysis of Ficus species and Chemical Constituents

The network graph generated in Fig. 3 from the analysis of *Ficus* species and their associated chemical constituents comprises a total of 142 nodes and 218 directed edges. This graph is composed of two distinct categories of nodes: one representing the 16 *Ficus* species and the other representing 126 bioactive compounds. The structure of the graph provides a detailed visualization of the relationships between these species and their respective chemical compounds.

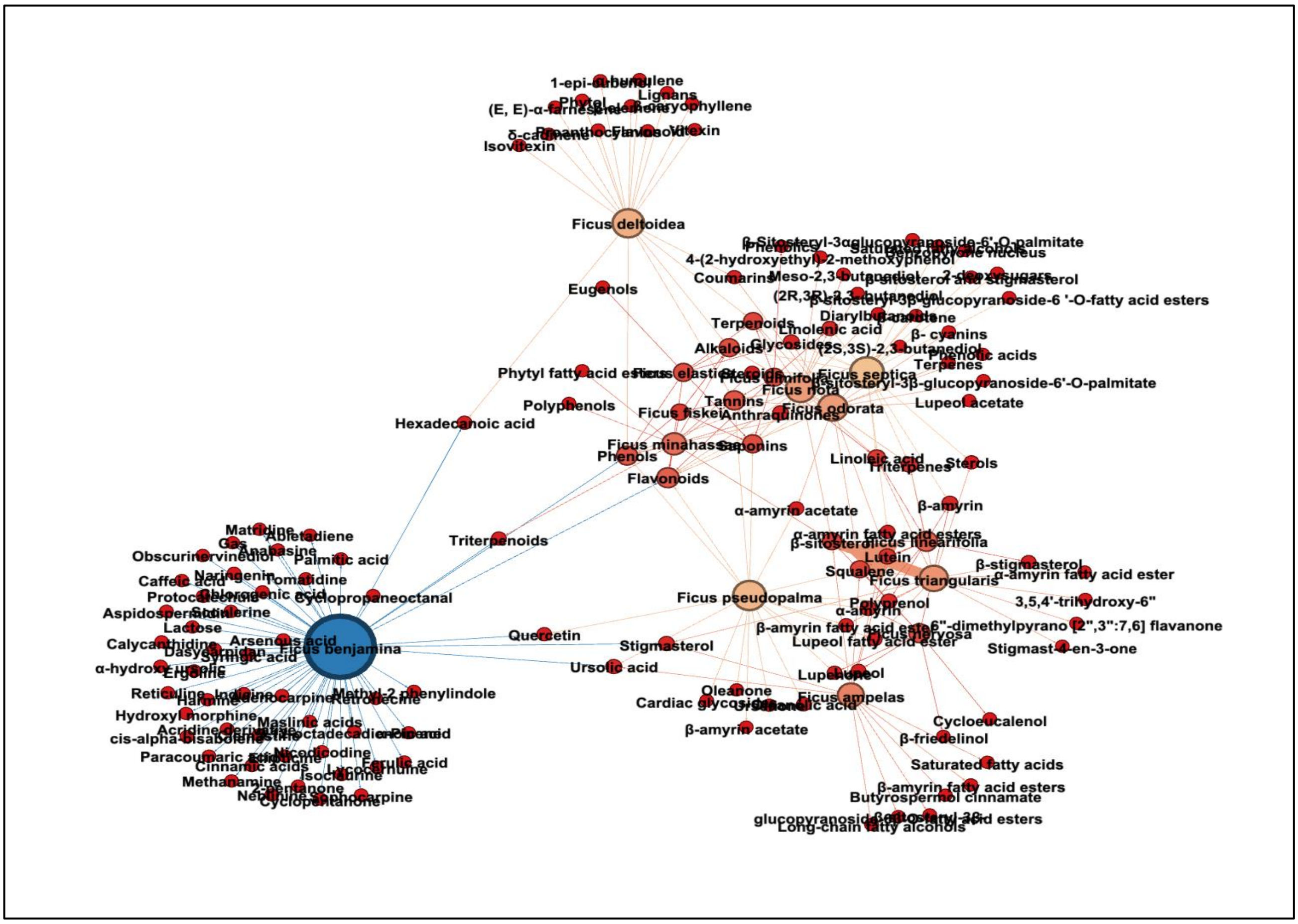

Figure 3: Plant-Metabolite Bipartite Network of the *Ficus* species and their Chemical Constituents

The network's density is calculated at 0.011, indicating a relatively sparse network in terms of the overall number of connections between the nodes. In other words, while there are several connections in the network, the proportion of possible connections to actual connections remains low, which suggests that not all *Ficus* species are equally connected to every bioactive compound.

The edges within this network represent the links or nexuses between the nodes, symbolizing the presence of a specific bioactive compound within a particular *Ficus* species. Each edge shows a direct connection, highlighting the chemical diversity across the species and allowing for the identification of which bioactive compounds are associated with each *Ficus* species.

The directed nature of the edges further emphasizes the direction of influence or association, suggesting that a particular bioactive compound is sourced from a specific *Ficus* species, rather than the other way around. This directed relationship provides clarity in tracing the origin of each bioactive compound, offering insights into how these compounds may function within the plant species or contribute to their biological activities.

Figure 3 reveals key insights into the relationships between various species and their associated bioactive compounds. The graph demonstrates an Average Degree of 1.535, suggesting that, on average, each node in the network is connected to approximately 1.535 other nodes. This statistic provides a general sense of the network's connectivity and the number of interactions between different species and their bioactive compounds.

Among the species represented in the graph, *Ficus benjamina* emerges as the most connected, with a prominent total of 53 edges. This high degree of connectivity indicates that *Ficus benjamina* is linked to an impressive 53 distinct bioactive compounds, which signifies the species' extensive chemical diversity. Such a large number of bioactive compounds suggests that this *Ficus* species could be of significant interest in pharmacological, ecological, and agricultural studies, as it likely possesses a broad spectrum of bioactive properties.

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In second place is *Ficus septica*, which is connected to 20 bioactive compounds. Although this number is considerably lower than that of *Ficus benjamina*, it still suggests a relatively high level of chemical diversity within the species. The 20 bioactive compounds associated with *Ficus septica* indicate that it plays a notable role in the network, potentially offering valuable compounds for future research and applications in various fields.

Following *Ficus septica*, *Ficus pseudopalma* is connected to 19 bioactive compounds, reflecting a strong, albeit slightly lesser, chemical diversity compared to *Ficus septica*. This indicates that *Ficus pseudopalma* is also a relevant species in the context of bioactive compounds, though it might not have as extensive a profile as the previous two species.

Finally, *Ficus deltoidei* has 18 bioactive compounds associated with it, placing it at the lower end of the connectivity spectrum among the species shown in the graph. While it contains fewer bioactive compounds than the previous species mentioned above, its inclusion in the network still indicates potential significance, particularly in specific areas where the compounds it produces could offer unique benefits.

Among the bioactive compounds represented in the network, phenols stand out with the highest in-degree, indicating their widespread occurrence across the *Ficus* species in the Philippines. Specifically, phenols are associated with 11 out of the 16 *Ficus* species analysed, underscoring their significant presence and potential importance within the genus. This suggests that phenols are a common and perhaps integral component of the chemical profiles of these species, likely contributing to their bioactivity and possible therapeutic applications.

Following phenols, flavonoids exhibit the second-highest in-degree, being identified in 10 *Ficus* species. Flavonoids are well-known for their diverse bioactive properties, including antioxidant,[36] anti-inflammatory,[37] and potential anticancer effects,[38] making their prevalence across these species noteworthy. Their relatively high occurrence further highlights the chemical richness of the genus and the potential for flavonoids to play a key role in the biological activities of these plants.

Next in the ranking are tannins and β-sitosterol, each with an in-degree of 8, meaning they are present in 8 of the 16 species. Tannins, recognized for their astringent properties [39] and contributions to plant defence mechanisms, are valuable in both ecological and medicinal contexts. Similarly, β-sitosterol, a plant-derived sterol, is known for its potential health benefits, such as cholesterol-lowering effects, anti-inflammatory, and analgesic properties.[40] Their shared in-degree emphasizes their importance within the network and hints at their potential as key bioactive compounds in the *Ficus* genus.

Network Analysis of Ficus species and Proven Pharmacological Effect

The network graph generated in Fig. 4 from the analysis of *Ficus* species and their associated pharmacological benefits is composed of 49 nodes and 63 directed edges. These nodes are divided into two main categories: 20 nodes representing the different *Ficus* species and 29 nodes signifying the pharmacological benefits attributed to these species. The structure of the graph provides a detailed visualization of the nexuses between these species and their respective pharmacological benefits.

The network's density, measured at 0.027, indicates a sparse graph where only a small proportion of all possible connections exist. Additionally, the average degree of the graph is calculated to be 1.286, meaning that each node is linked to approximately 1.3 others on average.

Among the *Ficus* species, *Ficus deltoidea* stands out as the most significant, being associated with 11 out of the 29 pharmacological benefits identified in the network. These include antioxidant, anticancer, anti-inflammatory, antibacterial, antidiabetic, antihypertensive, antiviral, wound-healing, anti-angiogenic, anti-oral ulcer, and aphrodisiac effects. This makes *Ficus deltoidea* the focal species in the network, with the highest potential for diverse therapeutic applications.

Close behind, *Ficus nota* and *Ficus septica* stand out as significant contributors to the network, each being associated with eight distinct pharmacological benefits. These benefits underscore their potential therapeutic value and mark them as noteworthy species within the genus. Although they do not surpass the versatility of *Ficus deltoidea*, their consistent presence across multiple pharmacological categories highlights their importance in the broader context of medicinal applications. Their specific contributions suggest potential avenues for targeted research and utilization, emphasizing their relevance in pharmacological studies.

Figure 4 highlights the pharmacological benefits of *Ficus* species, revealing a distinct and noteworthy trend. Among these benefits, antioxidant properties emerge as the most prominent and widely represented, underscoring their prevalence and significance within the studied species. Among the 20 subject species, 11 exhibit antioxidant effects, as evidenced by the highest in-degree value within the network. This suggests that over half of the analysed *Ficus* species possess compounds or mechanisms contributing to antioxidant activity, a critical property in combating oxidative stress and its related diseases, including cardiovascular disorders and neurodegenerative conditions.[41] This prominent association underscores the therapeutic potential of *Ficus* species as a rich source of natural antioxidants.

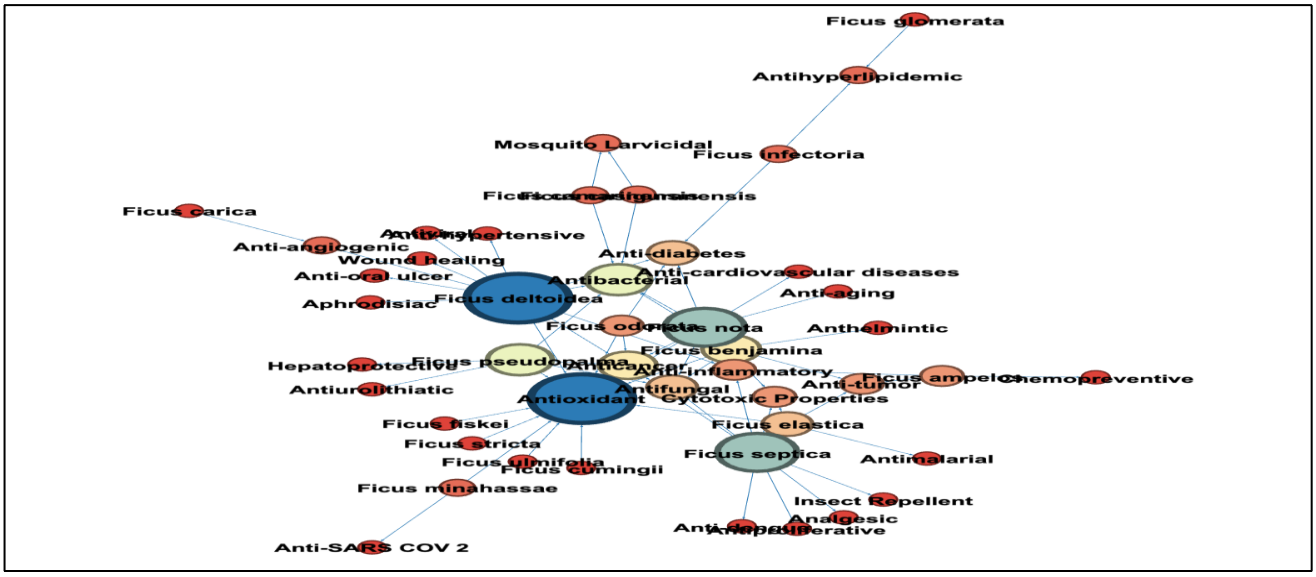

Figure 4: Plant-Benefits Bipartite Network of *Ficus* species and its Proven Pharmacological Benefits

The second most common pharmacological property is antibacterial activity, observed in 6 of the 20 species, corresponding to an in-degree of 6. This finding highlights the role of *Ficus* species in addressing bacterial infections, which remains a pressing global health concern,

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particularly in light of increasing antibiotic resistance.[42] The presence of antibacterial compounds in these species could have significant implications for the development of alternative or complementary treatments derived from natural sources.

Anticancer activity ranks third in prevalence, with an in-degree of 5, indicating its presence in 5 species. This finding suggests that these *Ficus* species may harbour bioactive compounds capable of modulating cancer-related pathways, presenting a promising avenue for further research into plant-based cancer therapeutics.

Lastly, antidiabetic and antifungal activities, each associated with an in-degree of 4, are found in 4 species. The antidiabetic property aligns with the traditional use of *Ficus* species in managing blood sugar levels,[43] while the antifungal activity suggests potential applications in combating fungal infections, which are often challenging to treat due to limited antifungal agents.

Conclusion

The *Ficus* species found in the Philippines represent a rich reservoir of medicinal potential within the genus. This systematic review provides a comprehensive synthesis of their chemical constituents, ethnobotanical uses, and pharmacological properties, highlighting the significant therapeutic promise of these plants in the context of traditional Filipino medicine. By integrating traditional knowledge with modern pharmacological validation, supported by network analyses, the study elucidates the intricate relationships among bioactive compounds, traditional applications, and experimentally validated pharmacological effects.

Two network analyses were employed to generate deeper insights into these connections. The first mapped *Ficus* species to their corresponding bioactive compounds, revealing the dominance of phenolic compounds, flavonoids, and tannins—chemical classes widely recognized for their antioxidant, anti-inflammatory, antimicrobial, and anticancer activities. Notably, *Ficus benjamina* emerged as the species with the highest number of identified bioactive compounds, including 2-pentanone, hexadecanoic acid (palmitic acid), 9,12-octadecadienoic acid, methanamine, cyclopentanone, methyl-2-phenylindole, cyclopropaneoctanal, arsenous acid, chlorogenic acid, p-coumaric acid, ferulic acid, syringic acid, caffeic acid, ursolic acid, protocatechuic acid, and maslinic acid. The second network linked *Ficus* species to their proven pharmacological benefits, identifying antioxidant, antibacterial, anticancer, antidiabetic, and antifungal activities as the most prominent across species. Among them, *Ficus deltoidea* exhibited the highest number of significant pharmacological effects (11), including anti-angiogenic, antihypertensive, anti–oral ulcer, antibacterial, anticancer, antidiabetic, anti-inflammatory, antioxidant, antiviral, aphrodisiac, and wound-healing activities. Overall, antioxidant activity emerged as the most prevalent pharmacological benefit among the Philippine *Ficus* species examined.

Despite these promising findings, substantial research gaps remain. Many traditional uses lack sufficient scientific validation, underscoring the need for robust mechanistic studies to clarify the biochemical pathways and molecular targets of *Ficus*-derived bioactive compounds. Additionally, the scarcity of clinical trials assessing the safety, efficacy, and therapeutic applicability of isolated compounds or standardized extracts represents a major barrier to their integration into modern medicine. Conservation challenges further emphasize the importance of sustainable harvesting practices to preserve these valuable plant resources.

To advance the understanding and utilization of Philippine Ficus species, future research should prioritize: (i) mechanistic studies to elucidate molecular targets and pathways; (ii) clinical trials to evaluate safety, efficacy, dosage, and therapeutic applications in human populations; (iii) toxicological assessments to establish safe dosage ranges and long-term effects; (iv) pharmacokinetic and pharmacodynamic investigations to determine absorption, distribution, metabolism, and excretion profiles; and (v) sustainable harvesting and conservation strategies to protect biodiversity. Addressing these gaps will be essential for unlocking the full therapeutic potential of Philippine Ficus species and fostering the development of innovative, effective, and sustainable plant-based medicines.

Conflict of Interest

The authors declare no conflict of interest.

Authors' Declaration

The authors hereby declare that the work presented in this article is original and that any liability for claims relating to the content of this article will be borne by them.

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