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Review Article

"PHYTOCONSTITUENTS AND PHARMACOLOGICAL INSIGHTS OF *FICUS KRISHNAE*: A TRADITIONAL PLANT WITH MODERN RELEVANCE"

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ABSTRACT

Ficus species are of significant importance since ancient time. Apart from religious and aesthetic utility, various species of the genus are also used in the traditional medicine or in day-to-day life as food. *Ficus krishnae* is observed as indigenous to India, and it is very well known for having its cup-shaped leaves, and it is used a folklore medicine, which is used to treat various diseases. It has a great cultural significance because of the stories that are associated with it. Different parts of *F. krishnae* have been investigated for the presence of various bioactive components like flavonoids, steroids, glycosides, alkaloids, fats, oils, proteins, and carbohydrates. This review summarizes the various botanical aspects, phytochemistry, biological properties, and commercial importance of the plant.

Keywords: *Ficus krishnae*, Botanical aspects, Therapeutic potential, Flavonoids.

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INTRODUCTION

Herbal medicines are observed as the rich resources of traditional medicines, and making use of these medicinal plants, many more modern medicines can be manufactured [1-4]. The use of the medicinal plants has been found for thousands of years and with promising results to treat various health disorders and to combat disease pandemic [5-10]. The realization of utilization of medicinal plants have been come into practice after a struggle against illness, as a consequence of which man has absorb the knowledge to use drugs from seeds, fruit bodies, bark, and other parts of the plant [11-18]. Over the past few years, the use of synthetic drugs has upraised the health-related problems due to their adverse reactions and showing multiple resistivities by various microorganisms, which are pathogenic [19-23]. In addition, antibiotics also show some adverse drug reactions on the host, which include immune suppression, hypersensitivity reactions, and various allergic reactions, due to which the plant-based medicines receiving more attention around the world. *Ficus* is one of the substantial genus, which is comprised of around 800 species [24-28]. *Ficus krishnae* is chiefly found in tropical Africa, Sri Lanka and India, which is very distinctive among all the species [29,30]. *F. krishnae* is associated with a unique character of being having a fold like a pocket at its base [31-33].

BOTANICAL ASPECTS

The cup-like shape of the leaf, tree height, and appendages of leaf, aerial roots, stipules size and shape, and petiole of *F. krishnae* make it different from *Ficus benghalensis*. One of the mythological stories behind the cup-like structure of the leaf of the *Ficus krishae* includes that Krishna, in his childhood, was very fond of eating butter that he would steal butter from his own house and from the other houses also. One day, when his mother "Yashoda," caught him, then he tried well to hide that butter by rolling it in the leaves of *F. krishnae* [31]. It was believed that since then, the leaves of this tree have this shape [34]. Another mythological tale describes that the leaves were redesigned by GOD Rama, so that these leaves can be utilized as a spoon or cup in the forest [35-37]. *F. krishnae*, is well known by different names like, in Hindi it is called as Makkhann Katori, in English, it is familiar with the names like Krishna's butter cup, Krishna bor, Krishna cup, and Krishna fig., in Sanskrit known as Krishna badh, and in Manipuri it is famous with the name of Krishna Khongang [34]. *F. krishnae* is a species which belongs to the Moraceae family. It represents a class of Dicotyledonae, which reflects a pivotal role in nature. Around 37 genera and 1100 species are found in the family Moraceae [34,38].

F. krishnae is a monoecism tree having small to medium size, with a white milky sap. Leaves of the tree are found in variable shapes, cup-shaped in general at the base, sometimes found simple. Petioles in the leaves are located at different positions, starting from the base to apex [39]. The leaf is having an elliptical lamina, which is pyramidal at its base. Margins are puberulous, white, and obtuse at the apex. Bark of the tree is grey in color having dispersed lenticels. Stipules base is obtuse [40]. The stigma of the female flower is linear, feathered, or compressed, whereas the male flower is associated with the maximum concentration of ostiolar region, long pedicle, and long, entire margins and acute to obtuse at the apex [41]. Cup formation is the everlasting quality of *F. krishnae*, trifoliation formation is not steady, but the presence of this feature definitely made it a different from the other species of the genus [41-43]. One of the study has investigated the effect of layering of air and effect of change in season of mature plant of *F. krishnae*, mainly in pre-monsoon, that is, in the month of mid-march to mid-June, monsoon, that is, during the month of mid-June to mid-September and also in post monsoon, that is, during the month of mid of September to mid of December. Rooting hormone indole butyric acid is used to check the initiation of root. The initiation of the root was noted after 40 days, and results are noted after every 10^{th} day for 2 months. The results have shown that the pre-monsoon is the best season for conducting the air layering experiments [44].

F. krishnae is a characteristic member of the genus *Ficus*, the detailed morphology and the molecular analyses support its taxonomical distinction from *F. benghalensis* and other species and which shows a significant difference in morphology of leaf, stipules, structure of petiole, and aerial roots. Some other features, such as ostiolar bracts, number of chromosomes, and DNA content supports its recognition as a separate species rather than only a variety or subspecies of *F. benghalensis* [45,46]. By comparing two important, widely distributed and ecologically significant representative of the genus *F. benghalensis* with *Ficus religiosa*, important insights into the species delimitation,

adaptive strategies, and reproductive ecology can be provided [47,48]. Although the three species share basic syconium structure and obligatory fig-wasp mutualism of the genus still they are greatly different in the terms of architecture of leaf, cytogenetic profiles, and the responses towards the abiotic stress [49,50]. In the traditional medicines, closely related species can be used interchangeably, and such interspecific comparisons are found essential for the taxonomic authentication and pharmacognostic standardization. Some of the morphological, cytological, and ecological and conservation- related characteristics distinguishing *F. krishnae* from closely related species are summarized as follows [Table 1].

CHEMICAL CONSTITUENTS OF *F. KRISHNAE*

F. krishnae is considered as one of the most primitive folk medicine. Pharmacognostic exploration on its various characteristics has shown its capability for various medicinal uses [26,66]. Different parts of *F. krishnae* have been extracted by making use of different solvent systems, which have shown the presence of numerous active constituents which are responsible for treatment of various diseases [67,68]. *Ficus* species have been found to be having presence active compounds like flavonoids, saponins, glycoside, phenols, steroids, alkaloids, coumarins, tannins, and Vitamin E [69-72]. Extraction of stem bark is done by using methanol, hexane, and water. Hexane extracts were further isolated and have found to show the presence of important triterpene alcohols like cycloartenol and 24-methylenecycloartanol, which were further characterized by mass spectrometry (MS) and nuclear magnetic resonance (NMR) spectroscopy. These triterpene alcohols exert antidiabetic activity. Cycloartenol and 24- methylenecycloartanol, act by protecting the β- cells from glucotoxicity and thereby improve the population of β- cells. This will normalize the releasing of insulin from β pancreatic cells [73-77]. Some of the major phytochemical constituents identified from *F. krishnae* are illustrated in Fig. 1. Twelve bioactive compounds were recognized from the methanolic extract of stem bark, which have shown significant biological activities like asthma, anti-bacterial, antioxidant, antiprotozoal, and anti-viral actions, in extracts of petroleum ether. Gas chromatography (GC)- MS analytical technique has been used for the reorganization of these active compounds [78]. The major chemical constituents reported from different parts of *F. krishnae* are summarized in Table 2.

For phytochemical fingerprinting, the assessment of qualitative and quantitative bioactive chemicals in medicinal plants can be assessed using high-performance thin-layer chromatography (HPTLC) techniques. Flavonoids, phenolic compounds, triterpenes, alkaloids, saponins, and tannins have been found in various species of *Ficus*, which indicates ethnomedicine significance of the plants [79-81]. By considering those phytoconstituents, HPTLC is found to be an analytical technique and tool for the standardization and quality assurance [82,83]. For instance, HPTLC plates, which are pre-coated with silica gel 60 F254, can be utilized to analyze hexane extracts mixed with non-polar triterpenoids. For example, a mobile phase in a ratio of 8:2 v/v of toluene: ethyl acetate can offer an adequate resolution of triterpenes [84-86].

Gas chromatography – Mass spectroscopy investigations of methanolic extracts of leaves of *F. krishnae* are found to contain biologically active constituents. These investigated compounds are responsible for various activities, including antineoplastic, anesthetic, antimutagenic, sclerosant, anti-inflammatory, cytoprotectant, antiulcerative, and antithrombotic [39,87,89]. Methanolic extract of *F. krishnae* was isolated and found to have the presence of an active compound, which is a phytol (diterpene), named 3,7,11,15- Tetramethyl-2-hexadecen-1-ol [90,91]. Petroleum ether, Chloroform, methanol, and aqueous extracts of the tree were investigated for the presence of phyto compounds and various primary metabolites, including lipids, proteins, and carbohydrates. In addition, the stem bark of *F. krishnae* has also been investigated for the presence of some of the minerals such as potassium, calcium, manganese, zinc, vanadium, magnesium, and titanium [9]. Ethanolic extracts of leaves of *F. krishnae*, followed by fractionation with petroleum ether and benzene, were done and have shown the presence of a halogenated coumarin named 3-chloro-7-methoxy-4-methyl-chromen-2-one [88].

PROPOSED STRUCTURE ACTIVITY RELATIONSHIP (SAR) OF MAJOR PHYTOCONSTITUENTS OF *F. KRISHNAE*

The pharmacological efficacy of *F. krishnae* can be systematically correlated with the chemical structure of its principal phytoconstituents. Major classes of compounds, including terpenoids, phenolic compounds, fatty acids, and coumarins, contain distinct functional moieties that govern their interaction with biological targets [92]. Elucidation of SAR therefore provides a mechanistic and chemical rationale for the observed therapeutic potential of this plant [89,93,94].

1. Triterpene alcohols, including cycloartenol and 24-methylenecycloartanol, feature a rigid tetracyclic framework with hydroxyl groups that promote interactions with cell membranes and intracellular enzymes. Additional structural elements, such as unsaturation and methyl groups in the side chains, increase their lipophilicity and enhance membrane permeability. These chemical characteristics are thought to underlie their antidiabetic effects, helping to preserve pancreatic β-cell function and regulate glucose metabolism [73,95].
2. Phenolic compounds: Kaempferol, a representative flavonol, possesses hydroxyl groups at defined positions that support their antioxidant and anti-inflammatory activities by facilitating hydrogen donation and free radical scavenging (Fig. 2). The planar, hydrophobic structure of these compounds further promotes interactions with inflammatory mediators and microbial membranes, which may account for their observed antibacterial and anticancer effects [96].
3. Phytol: Phytol, a diterpene alcohol characterized by a long aliphatic chain and a terminal hydroxyl group, demonstrates notable

Table 1: Comparative botanical characteristics of selected *Ficus* species

Characteristics	*Ficus krishnae*	*Ficus benghalensis*	*Ficus religiosa*
Base of leaf	Cup-shaped pocket	Broadly rounded [51-53]	Elongated drip tip [55]
Height of tree	10–15	20–30 [54,56]	15–25
Morphology syconia	Enclosed, small	Clustered	Medium axillary [57,58]
Native-Range	Sri Lanka, Tropical Africa, India	South east Asia, India sub-continent [59]	South east Asia, India sub-continent [64]
Mutualism	Specific fig–wasp interaction	Fig–wasp mutualism [60]	Fig–wasp mutualism
Pattern of phenological	Pollinator entry influenced reproductive synchrony [61]	Keystone resource species with asynchronous fruiting	Seasonal peaks in the phenology of fruiting and prolong leaves
Adaptation to abiotic stress	Exhibits metabolic and phenotypic adaptation to drought stress and temperature.	High tolerance to drought and urban stress	Adapted to mild water stress and heat
DNA content and chromosomes number	Evidences of DNA barcoding and cytology supports a different genetic identity from *Ficus benghalensis* [62,63]	Unique cytogenic profile of Moraceae	The stable diploid genome of Section Urostigma [65]

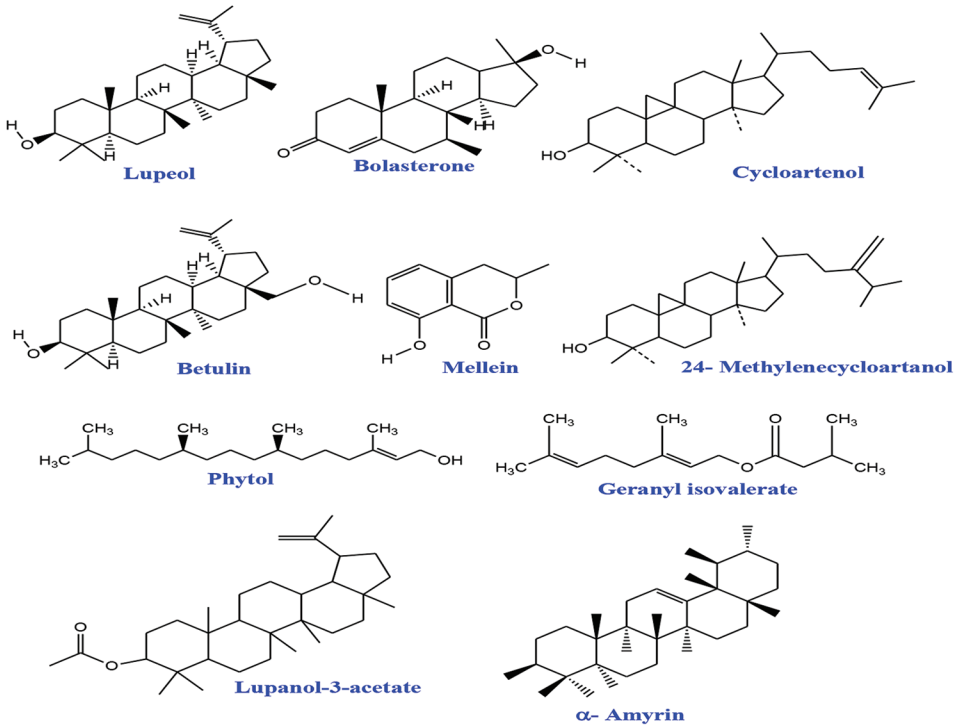


Fig. 1: Structures of important chemical constituents of *Ficus krishnae*

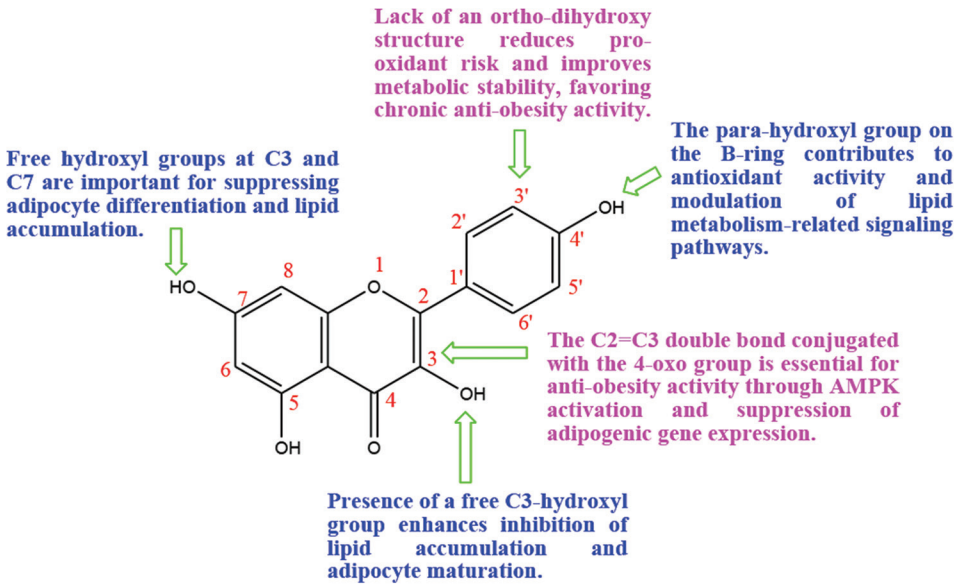


Fig. 2: Kaempferol structure and functional groups responsible for its anti-obesity activity

Table 2: Major chemical constituents reported from different parts of *Ficus krishnae*

S. No.	Plant part used	Solvent used	Identified chemical constituents	Class of constituents	References
1	Stem bark	Hexane	Cycloartenol, 24-methylenecycloartanol	Triterpene alcohols	[73]
2	Stem bark	Methanol	Lupeol, Betulin, n-Hexadecanoic acid, Oleic acid, 9,12,15-Octadecatrienoic acid	Triterpenes, SFatty acids	[26]
3	Stem bark	Petroleum ether	Cholestenone derivatives, steroidal compounds	Steroids	[26]
4	Leaves	Methanol	Phytol, Dimethyl phthalate, n-Hexadecanoic acid, 1,6-anhydro-β-D-glucopyranose	Diterpenes, fatty acids, carbohydrate	[87]
5	Leaves	Ethanol	3-Chloro-7-methoxy-4-methyl-chromen-2-one	Halogenated coumarin	[88]
6	Leaves and stem	Methanol (aqueous)	Flavonoids, phenols, tannins, saponins, glycosides	Polyphenols and glycosides	[69]
7	Stem bark	Aqueous	Alkaloids, phenolics, proteins, carbohydrates	Secondary and primary metabolites	[26]

antioxidant and cytoprotective effects (Fig. 3). Its unsaturated hydrocarbon chain facilitates interactions with lipid radicals, while the hydroxyl group contributes to the neutralization of reactive oxygen species. Together, these structural features are believed to underlie its anti-inflammatory, antithrombotic, and membrane-stabilizing activities [97-99].

4. Flavonoids: Phenolic compounds and flavonoids in *F. krishnae* are distinguished by multiple hydroxyl groups attached to their aromatic rings (Fig. 4). These structural elements facilitate electron donation and metal ion chelation, mechanisms that are central to their antioxidant and anti-hemolytic activities. Furthermore, the number and position of the hydroxyl groups play a critical role in determining their effectiveness as radical scavengers [100-102].
5. Coumarins: The halogenated coumarin 3-chloro-7-methoxy-4-methyl-chromen-2-one demonstrates enhanced biological activity, largely attributed to the presence of a chlorine atom, which increases lipophilicity and metabolic stability (Fig. 5). The methoxy group further promotes membrane permeability, potentially boosting its anti-inflammatory and antimicrobial effects [103]. Such chemical modifications are also thought to strengthen interactions with biological targets, contributing to its pharmacological potency [104,105].

Overall, the wide-ranging chemical structures of *F. krishnae* constituents – including their hydroxylation patterns, ring frameworks, and lipophilic side chains – are key determinants of their biological activities. The structural features, functional importance, and major bioactivities of these phytochemical classes are summarized in Table 3. Understanding these SAR helps to explain both the traditional uses of the plant and the pharmacological effects observed in experimental studies [106].

Molecular basis underlying the pharmacological effects of *F. krishnae*

Pharmacological properties of *F. krishnae* can be described using SAR of the phytoconstituents present in the plant, especially flavonoids, triterpenoids, diterpenes, and coumarins [120-122]. The phytoconstituents possess distinct structural elements such as conjugated aromatic systems, hydroxyl substitutions, rigid and cyclic structures, and lipophilic side chains, and these structural elements affect the interaction with enzymes, membranes, transcription, and intracellular signaling pathways [123-126]. Triterpene alcohols like cycloartenol and 24- methylenecycloartanol possess a tetracyclic structure, which is similar to a sterol structure, and contain hydroxyl group along with hydrophobic side chains. As they appear like endogenous sterols, they can be added to lipid bilayers and this will change the fluidity of the membrane and the signaling complexes, which are connected to receptors [127,128]. Hence, these compounds are assumed to enhance insulin efficacy by stimulation of the (Phosphatidylinositol 3-kinase/Protein Kinase B) PI3K/Akt signaling pathway that will facilitate the translocation of GLUT4 [129,130]. This will inhibit the synthesis of glucose-6-phosphatase (Phosphoenolpyruvate carboxykinase [PEPCK]) along with the other gluconeogenic enzymes in liver. In addition, by diminishing the activation of Nuclear Factor kappa-light-chain-enhancer of activated B cells (NF- κB) and inducing oxidative stress, mitochondrial dysfunction may contribute to preservation of pancreatic β-cells, thus strengthens their capacity to resist diabetes [131-134].

Flavonoids, like kaempferol and related polyphenols, found in *F. krishnae* are characterized by the presence of multiple hydroxyl groups which are bonded to aromatic ring. These groups provide electron donation and chelation of metal ions [135-138]. Particularly, the arrangement of ortho-dihydroxyl provides a significant capacity for radical scavenging. Flavonoids are recognized for their ability to

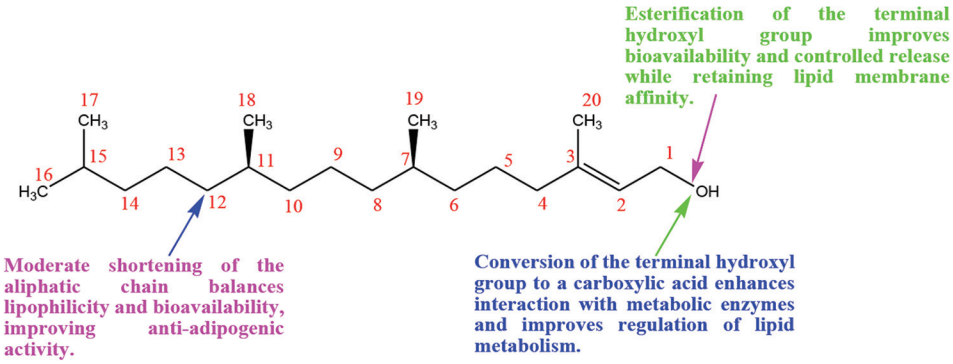


Fig. 3: Functional group modifications of phytol to enhance anti-obesity activity

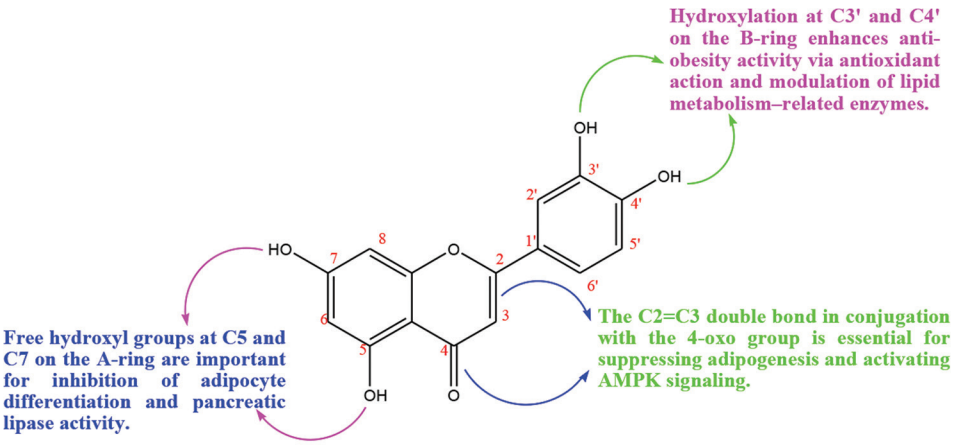


Fig. 4: Structure of flavonoids and the labeled functional groups for anti-obesity activity

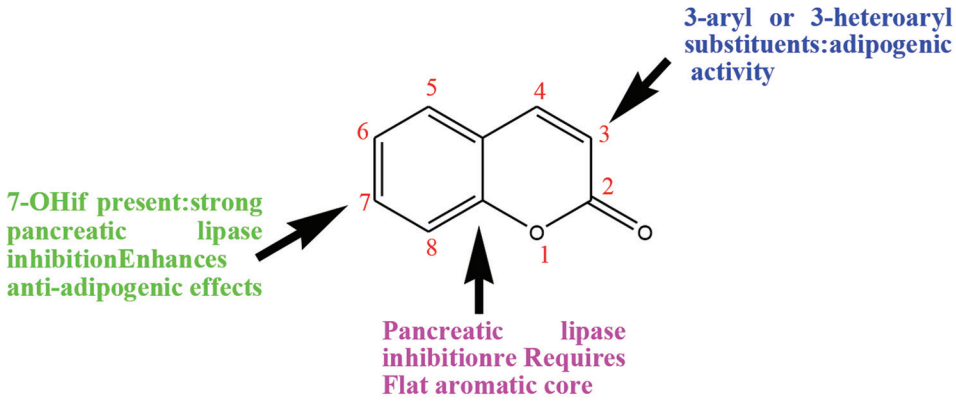


Fig. 5: Structure of coumarin derivatives and key functional groups influencing anti-obesity activity

Table 3: Major bioactive compound classes and their functional roles in *Ficus krishnae*

Compound class	Key structural features	Functional importance	Main bioactivity
Flavonoids	Hydroxylation, C2=C3 double bond, 4-oxo, glycosides	Radical scavenging, enzyme modulation	Antioxidant, anti-obesity, antidiabetic [107-110]
Triterpenes	Pentacyclic/tetracyclic skeleton, hydroxyl groups, methylation	Membrane interaction, enzyme modulation	Antidiabetic, anticancer, anti-inflammatory [111,112]
Diterpenes (Phytol)	Long aliphatic chain, terminal OH, unsaturation	Lipid radical scavenging, membrane protection	Antioxidant, anti-inflammatory [113]
Phenolics	Multiple OH, ortho/para substitution	Radical scavenging, metal chelation	Antioxidant, anti-hemolytic [114-116]
Coumarins	Halogenation, methoxylation, methyl groups	Lipophilicity, metabolic stability	Anti-inflammatory, antimicrobial, anticancer [117]
Fatty acids	Chain length, degree of unsaturation, carboxyl group	Enzyme interaction, membrane fluidity	Anti-inflammatory, lipid-lowering [118,119]

activate adenosine monophosphate (AMP)-activated protein kinase at the molecular level and inhibit adipogenic transcription factors like peroxisome proliferator-activated receptor gamma and CCAAT/enhancer-binding protein alpha, and thus blocks pancreatic lipase, play a role as antiobesity agent. Moreover, concurrent NF-κB inhibition may further support anti-inflammatory and cytoprotective properties of flavonoids [139-142].

Lupeol, a pentacyclic triterpene, has properly positioned hydroxyl groups that may enable radical scavenging and hydrogen donation, and additionally their pentacyclic structural pharmacophore may improve their ability to interact with cellular membranes and inflammatory mediators [143-146]. Reduction in levels of pro-inflammatory cytokin (tumor necrosis factor-alpha, interleukin [IL]-1β, IL-6), Cyclooxygenase-2 (COX-2), is inhibited by these structural feature by suppression of NF-κB and mitogen-activated protein kinase (MAPK) (extracellular signal-regulated kinase [ERK], c-Jun N-terminal Kinase [JNK], p38). The anticancer activity of triterpenes can be explained by the modification of mitochondrial apoptotic pathway, which is explained by an increase in the ratio of Bax/Bcl-2 [147-149].

In general, the specific structural features such as level of unsaturation, hydroxylation patterns, and lipophilic side chains greatly influence the molecular interaction with signaling proteins and cellular membranes, which play a significant role in the biological action of *F. krishnae*. Some of the other structural requirements and the molecular mechanism interactions of the constituents, like halogenated coumarins and phytols, along with their pharmacological activity, are summarized in Table 4.

BIOLOGICAL ACTIVITY

1. The anti-hemolytic and anti-cancer activities: The anti-hemolytic potential of various *F. krishnae* stem bark extract fractions, such as petroleum ether, chloroform, aqueous, and methanol extract fractions, has been studied by employing an erythrocyte membrane stabilization test. Among the tested fractions, the methanol extract fraction showed the maximum protective potential against hemolysis, which was followed by the chloroform, petroleum ether, and aqueous extract fractions. The results of the study showed that the protective potential of the *F. krishnae* stem bark extract fractions was concentration-dependent. The protective potential of the extract fractions increased with an increase in the concentration of the extract [163-165]. Evaluation of the anticancer potential of *F. krishnae* extracts was also done by using breast cancer cell lines. The highest degree of cytotoxic activity was shown by petroleum ether extract, indicating 50% inhibition in cell viability, followed by the chloroform extract. This indicates that the bioactive constituents of the plant extract from non-polar solvent fractions may be responsible for its anticancer potential [166].
2. Antidiabetic activity: Enzyme α-amylase has been used to evaluate the antidiabetic activity of the stem bark of *F. krishnae*. Methanolic extract was tested for its inhibitory potential on the hydrolysis of starch by the enzyme α-amylase and its substrate starch using a spectrophotometric assay with 3,5-Dinitrosalicylic acid reagent and Acarbose as a standard inhibitor. The methanolic extract showed promising inhibitory activity on the enzyme α-amylase [167-170].
3. Antibacterial activity: Number of pathogenic bacteria such as *Salmonella typhimurium*, *Staphylococcus aureus*, and *Escherichia coli,* has been used for investigation of antimicrobial activity of aqueous stem bark extracts of *F. krishnae* using the agar diffusion assay. The antibacterial activity was evident from the results, indicating that the plant extract might be rich in bioactive substances that can inhibit the growth of microbes [105]. In addition, silver nanoparticles synthesized using the stem bark extract of *F. krishnae* have been reported to exhibit increased antimicrobial potential [166]. The biosynthesized nanoparticles also showed potential biological activity, including antitumor activity against ovarian cancer cell lines,

which indicates their potential use in biological studies [166,167]. Moreover, *F. krishnae* extracts showed significant antibacterial activity, with maximum zone of inhibition against *Clostridium perfringens*, indicating its potential as a source of antibacterial agents [69,171,172].

4. Antioxidant activity: The free radical scavenging potential of plant's extracts has been attributed to the presence of flavonoids and phenolic compounds, which are present in the leaves of the plant, as shown by the results so obtained. In the comparative analysis, the results have revealed the promising antioxidant potential of the plant's extracts compared to the standard antioxidant gallic acid, which indicates the potential use of the plant to act as a source of antioxidants. The results have revealed the free radical scavenging potential of the plant's extracts, which has been attributed to the flavonoids and phenolic compounds present in the plant's leaves. In the comparative analysis, the results have revealed the promising antioxidant potential of the plant's extracts compared to the standard antioxidant gallic acid, which indicates the potential use of the plant to act as a source of antioxidants [69,173].
5. Anti-inflammatory activity: *F. krishnae* has been explored for various bioactive compounds that play a key role in managing chronic inflammatory disorders. The anti-inflammatory potential of stem bark extracts using non-polar solvents like chloroform and petroleum ether has been tested using a denaturation inhibition assay, which is a widely used method to screen anti-inflammatory activity. The anti-inflammatory potential of stem bark extracts was significant, as they were able to inhibit heat-induced albumin denaturation. The results revealed that both chloroform and petroleum ether extracts showed significant inhibitory activity. This implies that non-polar bioactive compounds present in the stem bark of *F. krishnae* play a vital role in exhibiting anti-inflammatory potential [174].
6. Anticancer activity: Stem bark extracts, particularly petroleum ether and chloroform fractions, exhibit cytotoxicity against various cancer cell lines, including breast and ovarian cancer. Mechanistic studies suggest that triterpenoids and flavonoids disrupt cancer cell membranes, induce apoptosis, and modulate intracellular signaling pathways involved in cell proliferation. Recent research also highlights the use of silver nanoparticles synthesized using *F. krishnae* extracts, which enhance cytotoxicity selectively in tumor cells [174,175].

Other uses of *F. krishnae*: There are a number of commercially available insecticides and various repellents. As they have shown many serious impacts on human health as well as on the environment, commercially available insecticides are now can be replaced by many insecticides from botanical origin. Development of insecticides from natural or botanical origin probably may show non-toxic effects, eco-friendly, cost-effective, and the availability of these natural compounds makes them more attentive in the present era. Methanolic and ethyl acetate extracts of leaves of *F. krishnae* were investigated against 3rd instar larvae of *Culex vishnui* and *Anopheles stephensi* group at different concentrations.

Table 4: Molecular pathways associated with phytoconstituents reported in *Ficus krishnae* and related *Ficus* species

S. No.	Phytoconstituent	Structural properties	Molecular pathways	Pharmacological action	References
1	Triterpene alcohols	Lipophilic side chains, hydroxyl group, tetracyclic nucleus	inhibition of NF- κB	Antidiabetic, protection of β- cells	[150,151]
2	Flavonoids	Hydroxyl groups, phenolic aromatic rings	Downregulation of peroxisome proliferator-activated receptor gamma and CCAAT/enhancer-binding protein alpha, inhibition of NF- κB	Antioxidant, Antiobesity and anti-inflammatory activity	[152,153]
3	Pentacyclic triterpenes	Hydroxyl substitution, pentacyclic scaffold	Modulation of Bax/Bcl-2, suppression of NF-κB, and MAPK	Anticancer, anti-inflammatory, antimicrobial activity	[154,155]
4	Halogenated coumarins	Halogens, chromone nucleus	DNA gyrase inhibition, COX-2 inhibition	Anti-inflammatory and antimicrobial	[156-159]
5	Phytol	Terminal hydroxyl groups, unsaturated aliphatic chains	inhibition of NF- κB	Antioxidant, Anti-inflammatory, antithrombotic	[160-162]

Table 5: Phytoconstituents and mechanism of action

Phytoconstituent/class	Part of plant	Biological activity	Mechanism/notes	References
Triterpene alcohols (Cycloartenol, 24-methylenecycloartanol, Lupeol, Betulin)	Stem bark	Antidiabetic, Anti-inflammatory, Anticancer, Antioxidant	Stabilizes pancreatic β-cells, modulates glucose metabolism, inhibits inflammatory mediators, scavenges free radicals	[73,177]
Flavonoids and Phenolic compounds	Leaves, stem bark	Antioxidant, Anti-hemolytic, Anti-obesity, Antimicrobial	Electron donation, radical scavenging, membrane stabilization, metal chelation	[69,87]
Diterpenes (Phytol, 3,7,11,15-tetramethyl-2-hexadecen-1-ol)	Leaves	Antioxidant, Anti-inflammatory, Antithrombotic, Cytoprotective	Hydroxyl group neutralizes reactive oxygen species (ROS), interacts with lipid radicals, stabilizes membranes	[90]
Coumarins (3-Chloro-7-methoxy-4-methyl-chromen-2-one)	Leaves	Antimicrobial, Anti-inflammatory, Antioxidant	Halogenation increases lipophilicity and metabolic stability; methoxy substitution improves membrane permeability	[88]
Fatty acids (Oleic acid, n-Hexadecanoic acid)	Stem bark, leaves	Antimicrobial, Anti-inflammatory	Hydrophobic interactions with microbial membranes and inhibition of inflammatory pathways	[174]
Silver nanoparticles synthesized using plant extracts	Stem bark	Anticancer, Antimicrobial	Enhanced cellular uptake and increased ROS generation in microbial and tumor cells	[166]
Methanolic extracts	Stem bark, Leaves	Anti-hemolytic, Cytoprotective	Stabilizes erythrocyte membranes and prevents oxidative damage	[39]
Leaf extracts (methanol, ethyl acetate)	Leaves	Mosquito larvicidal activity	Disrupts larval development and inhibits enzymatic functions	[177]

The investigation has shown that solvent extracts of *F. krishae* have the potential to get control over the population of mosquito [176]. Some of the biological activities and their mechanism of action are summarized in Table 5.

Critical assessment and knowledge gap

Although numerous investigations have been assessed the medicinal potential of *F. krishnae*, yet there are notable gaps in the existing research. A significant proportion of the data comes from *in vitro* experiments, while the clinical investigations are still lacking. Consequently, the extent to which these results can be applied in medical settings is still unclear. Bioavailability of the phytochemicals found in *F. krishnae* is another significant limitation. Most of the plant-derived components, such as flavonoids and triterpenoids, suffer from low water solubility, poor systemic bioavailability, and rapid *in vivo* metabolism, leading to lower pharmacological efficacy [178,179]. Besides, comprehensive toxicity and safety assessments of the plant extracts are limited; therefore, long-term toxicological studies are needed to define safe dosage ranges in humans. In addition, there is an apparent variability in the phytochemical composition and pharmacological activity reported by different authors, most likely may be due to the differences in extraction methods, plant parts used, geographical origin of the sample, or experimental model. Thus, extraction methodologies and analytical methods standardization are certainly required to obtain reproducible and reliable results. Future studies should involve mechanistic studies, pharmacokinetic, and clinical trials to clarify the therapeutic utility of *F. krishnae*. Moreover, real advancements in new delivery devices like nanoformulations might overcome constraints of important phytoconstituents on bioavailability [180].

CONCLUSION

F. krishnae is a unique and valuable medicinal plant with a long history of traditional use, distinguished not only by its characteristic cup-shaped leaves but also by its diverse pharmacological potential. Scientific investigations have confirmed that its various parts – leaves, stem bark, and extracts – are rich in bioactive compounds such as triterpenes, flavonoids, phenolics, diterpenes, coumarins, and essential fatty acids. These phytoconstituents contribute to a wide spectrum of biological activities, including antioxidant, anti-inflammatory, antidiabetic, antimicrobial, anticancer, and antithrombotic effects. The SAR of these compounds provides insight into their mechanisms of action, from stabilizing pancreatic β-cells and scavenging free radicals to modulating enzyme activities and enhancing membrane protection. Notably, the use of *F. krishnae* -derived silver nanoparticles has opened new avenues for targeted anticancer and antimicrobial therapies. Beyond its medicinal value, the plant also offers eco-friendly solutions, such as natural mosquito larvicides, which highlight its potential in public health and sustainable practices. Overall, *F. krishnae* represents a promising source of therapeutic agents, validating its traditional uses and encouraging further research into its pharmacological applications and bioactive constituents. Harnessing its full potential could contribute to the development of safer, plant-based remedies for various human health challenges.

CONFLICTS OF INTEREST

The authors declare that they have no conflicts of interest.

AUTHORS' CONTRIBUTION

Conceptualization: Puneet Kaur, Dr Payal Mittal, and Dr Rajiv; Methodology and data collection: Puneet Kaur, Dr Payal Mittal, and Dr Rajiv; Literature review and draft writing: Puneet Kaur; Supervision and project administration: Dr Payal Mittal.

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REFERENCES

1. Dar RA, Shahnawaz M, Qazi PH. General overview of medicinal plants: A review. J Phytopharmacol. 2017;6(6):349-51. doi: 10.31254/phyto.2017.6608
2. Gurib-Fakim A. Medicinal plants: Traditions of yesterday and drugs of tomorrow. Mol Aspects Med. 2006;27(1):1-93. doi: 10.1016/j.mam.2005.07.008, PMID 16105678
3. Singh R. Medicinal plants: A review. J Plant Sci. 2015;3(1-1):50-5. doi: 10.11648/j.jps.s.2015030101.18
4. Sharma A, Sabharwal P, Dada R. Herbal medicine-an introduction to its history. In: Herbal Medicine in Andrology. Cambridge: Academic Press; 2021. p. 1-8. doi: 10.1016/B978-0-12-815565-3.00001-1
5. Grant JK, Dangl M, Ndumele CE, Michos ED, Martin SS. A historical, evidence-based, and narrative review on commonly used dietary supplements in lipid-lowering. J Lipid Res. 2024;65(2):100493. doi: 10.1016/j.jlr.2023.100493, PMID 38145747
6. Nsairat H, Khater D, Odeh F, Jaber AM, Al Sulaibi MA, Alshaer W, *et al*. Phytosomes: A modernistic approach to the delivery of herbal drugs. In: Advanced and Modern Approaches for Drug Delivery. Cambridge: Academic Press; 2023. p. 301-55. doi: 10.1016/B978-0-323-91668-4.00029-0
7. Shah S, Chauhan H, Madhu H, Mori D, Soniwala M, Singh S, *et al*. Lipids fortified nano phytopharmaceuticals: A breakthrough approach in delivering bio-actives for improved therapeutic efficacy. Pharm Nanotechnol. 2025;13(1):70-89. doi: 10.2174/0122117385277686231127050723, PMID 38279712
8. Thakur SH, Kaurav H, Chaudhary G. Karanj (*Pongamia pinnata*)-an ayurvedic and modern overview. Asian J Pharm Clin Res. 2021;14(6):14-21. doi: 10.22159/ajpcr.2021.v14i6.41367
9. Chopade VV, Tankar AN, Pande VV, Tekade AR, Gowekar NM, Bhandari SR, *et al*. *Pongamia pinnata*: Phytochemical constituents, traditional uses and pharmacological properties: A review. Int J Green Pharm. 2008;2(2):72-5. doi: 10.4103/0973-8258.41173
10. Pani A, Behera B, Mahalik G. Comparative analysis of phytochemical and antimicrobial activity of *Butea monosperma* (Lam.) Taub. and *Pongamia pinnata* (L.) Pierre: A review. Indian J Nat Sci. 2020;10:19368-73.
11. Petrovska BB. Historical review of medicinal plants' usage. Pharmacogn Rev. 2012;6(11):1-5. doi: 10.4103/0973-7847.95849, PMID 22654398
12. Wiart C. Ethnopharmacology of Medicinal Plants: Asia and the Pacific. Totowa, NJ: Humana Press; 2006. doi: 10.1007/978-1-59745-160-4_1
13. Alshammaa ZA, AlShammaa DA. The metabolic effect of medicinal plants and synthetic anti-obesity products on human health. Plant Sci Today. 2024;11:704-18. doi: 10.14719/pst.3206
14. Singh M, Thrimawithana T, Shukla R, Adhikari B. Managing obesity through natural polyphenols: A review. Future Foods. 2020;1-2:100002. doi: 10.1016/j.fufo.2020.100002
15. Swift DL, McGee JE, Earnest CP, Carlisle E, Nygard M, Johannsen NM. The effects of exercise and physical activity on weight loss and maintenance. Prog Cardiovasc Dis. 2018;61(2):206-13. doi: 10.1016/j.pcad.2018.07.014, PMID 30003901
16. Reyes-Farias M, Fos-Domenech J, Serra D, Herrero L, Sánchez-Infantes D. White adipose tissue dysfunction in obesity and aging. Biochem Pharmacol. 2021;192:114723. doi: 10.1016/j.bcp.2021.114723, PMID 34364887
17. Piché ME, Tchernof A, Després JP. Obesity phenotypes, diabetes, and cardiovascular diseases. Circ Res. 2020;126(11):1477-500. doi: 10.1161/CIRCRESAHA.120.316101, PMID 32437302
18. Hossain CM, Gera ME, Ali KA. Current status and challenges of herbal drug development and regulatory aspect: A global perspective. Asian J Pharm Clin Res. 2022;15(2):31-41. doi: 10.22159/ajpcr.2022.v15i12.46134
19. Wu C, Lee SL, Taylor C, Li J, Chan YM, Agarwal R, *et al*. Scientific and regulatory approach to botanical drug development: A U.S. FDA perspective. J Nat Prod. 2020;83(2):552-62. doi: 10.1021/acs.jnatprod.9b00949. PMID 31977211
20. Parasuraman S, Thing GS, Dhanaraj SA. Polyherbal formulation: Concept of Ayurveda. Pharmacogn Rev. 2014;8(16):73-80. doi: 10.4103/0973-7847.134229, PMID 25125878
21. Gan BH, Gaynord J, Rowe SM, Deingruber T, Spring DR. The multifaceted nature of antimicrobial peptides: Current synthetic chemistry approaches and future directions. Chem Soc Rev. 2021;50(13):7820-80. doi: 10.1039/d0cs00729c, PMID 34042120
22. Başaran N, Paslı D, Başaran AA. Unpredictable adverse effects of herbal products. Food Chem Toxicol. 2022;159:112762. doi: 10.1016/j.fct.2021.112762, PMID 34896186

23. Saggar S, Mir PA, Kumar N, Chawla A, Uppal J, Shilpa S, *et al*. Traditional and herbal medicines: Opportunities and challenges. Pharmacogn Res. 2022;14(2):107-14. doi: 10.5530/pres.14.2.15
24. Ali BH, Blunden G, Tanira MO, Nemmar A. Some phytochemical, pharmacological and toxicological properties of ginger (*Zingiber officinale* Roscoe): A review of recent research. Food Chem Toxicol. 2008;46(2):409-20. doi: 10.1016/j.fct.2007.09.085, PMID 17950516
25. Charen E, Harbord N. Toxicity of herbs, vitamins, and supplements. Adv Chronic Kidney Dis. 2020;27(1):67-71. doi: 10.1053/j.ackd.2019.08.003, PMID 32147004
26. Kanjikar AP, Londonkar RL. Pharmacognostic evaluation, phytochemical screening and antimicrobial activity of stem bark of *Ficus krishnae*. Int J Pharmacogn Phytochem Res. 2017;9(5):733-8. doi: 10.25258/phyto.v9i5.8156
27. Falistocco E. The world of figs: An overview. In: Uthup TK, Karumamkandathil R, editors. Economically Important Trees: Origin, Evolution, Genetic Diversity and Ecology. Singapore: Springer Nature Singapore; 2024. p. 261-98. doi: 10.1007/978-981-97-5940-8_7
28. Elish SE, Temraz A, Hassan Baky M. Phytochemical diversity of genus Ficus: A mini review. ERU Res J. 2023;2(3):502-24. doi: 10.21608/erurj.2023.310215
29. Chaudhary LB, Sudhakar JV, Kumar A, Bajpai O, Tiwari R, Murthy GV. Synopsis of the genus *Ficus* L. (Moraceae) in India. Taiwania. 2012;57(2):193-216. doi: 10.6165/tai.2012.57(2).193
30. Kumar M, Upadhyay SK, Verma PK, Sharma I, Singh R. Taxonomical and ethnomedicinal studies of *Ficus krishnae* L.(Dicotyledonae: Moraceae). Bull Pure Appl Sci Bot. 2021;40b(1):24-9. doi: 10.5958/2320-3196.2021.00005.7
31. Kumar R, Panda A, Majhi S, Tripathi G, Mishra S, Devi RS, *et al*. A note on *Ficus krishnae* C. DC. (Moraceae): Mythology of Lord Krishna & Sudama. J Biodivers Conserv. 2025;9(3):122-8. doi: 10.5281/zenodo.17193540
32. Kumar SN, Mishra S, Kumar S. A note on *Ficus hederacea* Roxb. (Moraceae). Species. 2022;23(71):144-7.
33. Satapathy S, Kumar S. Medicinal *Ficus* species of temple city of Odisha. J Biodivers Conserv. 2017;1(3):1-5.
34. Joshi MK, Gorwadiya HC, Pandya DJ. Phytopharmacognostical study on 'Makkan Katori': *Ficus krishnae*. Int J Biol Med Res. 2012;3(11):427-30.
35. Biswas K. Observations on the systematic position of *Ficus krishnae*. Curr Sci. 1934;3(8):424-7.
36. Tripathi R, Kumar A, Kumar S, Prakash S, Singh AK. *Ficus benghalensis* Linn.: A tribal medicine with vast commercial potential. Indian J Agric Allied Sci. 2015;1:95-102.
37. Linneaus C. Species Plantarum. Vol. 12. Stockholm: Biodiversity Heritage Library; 1753. p. 1200.
38. Dutta A, Khajuria R. Ethnobotany, phytochemistry and therapeutic potential of *Ficus krishnae* C. DC. Ecol Environ Conserv. 2025;31:356-9. doi: 10.53550/EEC.2025.v31i04s.055
39. Mahima K, Umapathy S, Sudhakar JV, Sathishkumar R. Systematic reinstatement of highly sacred *Ficus krishnae* based on differences in morphology and DNA bar coding from *Ficus benghalensis* (Moraceae). PhytoKeys. 2021;186:121-38. doi: 10.3897/phytokeys.186.74086, PMID 35002360
40. Anand KK, Jena SN, Chaudhary LB, Singh M. Conflict between morphological and molecular data: A case study of *Ficus krishnae* (Moraceae). Phytotaxa. 2016;247(2):143. doi: 10.11646/phytotaxa.247.2.7
41. Tiwari R, Sudhakar JV, Chaudhary LB, Murthy GV, Durgapal A. Revisit the taxonomy of *Ficus krishnae* (Moraceae). Phytotaxa. 2015;192(3):169. doi: 10.11646/phytotaxa.192.3.3
42. Puri GS. Further observations on the systematic position of *Ficus krishnae*. J R Asiatic Soc Bengal Sci. 1946;12(1):7-12.
43. Joshi S, Raghuvanshi SS. Accessory chromosomes in a tree-*Ficus krishnae*. Ann Bot. 1970;34(5):1037-9. doi: 10.1093/oxfordjournals.aob.a084434
44. Tomar A, Singh VR. Effect of air layering time (season) with the aid of indole butyric acid in *Ficus krishnae* and *Ficus auriculata*. Indian For. 2011;137(12):1363-5. doi: 10.36808/if/2011/v137i12/12260
45. Mostafa S, Hussein BA, Sayed HA, ElItriby HA, Hussein EH. Genetic diversity assessment among some *Ficus* species using morphological characters and AFLPS. Plant Archives. 2020;20(1):1395-404.
46. Andalil R, Mattumal R, Koppala Narayana SK. Anatomical profile of six different species of *Ficus* occurring in South India. J Res Siddha Med. 2023;6(2):58-67. doi: 10.4103/jrsm.jrsm_32_23
47. Zhang Y, Guan Y, Li Z, Wang Y, Chen C, Yang X, *et al*. The entry of pollinating fig wasps plays a pivotal role in the developmental phase and metabolic expression changes in *Ficus hookeriana* figs. Forests. 2025;16(1):165. doi: 10.3390/f16010165
48. Huang JF, Fungjanthuek J, Chen MB, Liu GX, Dong YY, Peng YQ, *et al*. Pollinator sharing and hybridization in a pair of dioecious figs sheds light on the pathways to speciation. Evol Lett. 2023;7(6):422-35. doi: 10.1093/evlett/qrad045, PMID 38045718
49. Cerezini MT, Rattis L, Furini PR, Pereira RA. Contrasting phenological patterns and reproductive strategies in closely related monoecious fig tree species. Plants (Basel). 2024;13(14):1889. doi: 10.3390/plants13141889, PMID 39065415
50. Yuan S, Yin T, He H, Liu X, Long X, Dong P, *et al*. Phenotypic, metabolic and genetic adaptations of the *Ficus* species to abiotic stress response: A comprehensive review. Int J Mol Sci. 2024;25(17):9520. doi: 10.3390/ijms25179520, PMID 39273466
51. Logesh R, Vivekanandarajah Sathasivampillai SV, Varatharasan S, Rajan S, Das N, Pandey J, *et al*. *Ficus benghalensis* L. (Moraceae): A review on ethnomedicinal uses, phytochemistry and pharmacological activities. Curr Res Biotechnol. 2023;6:100134. doi: 10.1016/j.crbiot.2023.100134
52. Alaaeldin R, Hassan HA, Abdel-Rahman IM, Mohyeldin RH, Youssef N, Allam AE, *et al*. A new EGFR inhibitor from *Ficus benghalensis* exerted potential anti-inflammatory activity via Akt/PI3K pathway inhibition. Curr Issues Mol Biol. 2022;44(7):2967-81. doi: 10.3390/cimb44070205, PMID 35877429
53. Singh P, Dhankhar J, Kapoor RK, Kumar D, Bhatia S, Harrasi AA, *et al*. *Ficus benghalensis*-a comprehensive review on pharmacological research, nanotechnological applications, and patents. J Appl Pharm Sci. 2023;13(10):59-82. doi: 10.7324/JAPS.2023.134426
54. Shim KH, Sharma N, An SS. Mechanistic insights into the neuroprotective potential of sacred *Ficus* trees. Nutrients. 2022;14(22):4731. doi: 10.3390/nu14224731, PMID 36432418
55. Babu K, Sabesan GS, Rai S. Comparative pharmacognostic studies on the barks of four *Ficus* species. Turk J Bot. 2010;34(3):215-24. doi: 10.3906/bot-0907-115
56. Khaliq HA. A review of pharmacognostic, physicochemical, phytochemical and pharmacological studies on *Ficus bengalensis* L. J Sci Innov Res. 2017;6(4):151-63. doi: 10.31254/JSIR.2017.6407
57. Murugesu S, Selamat J, Perumal V. Phytochemistry, pharmacological properties, and recent applications of *Ficus benghalensis* and *Ficus religiosa*. Plants (Basel). 2021;10(12):2749. doi: 10.3390/plants10122749, PMID 34961220
58. Joseph B, Raj SJ. Phytopharmacological and phytochemical properties of three *Ficus* species-an overview. Int J Pharma Bio Sci. 2010;1(4):246-53.
59. Ahad HA, Haranath C, Varam NJ, Ksheerasagare T, Krishna JV, Teja ST. Liver shielding activity of *Ficus benghalensis* fruit extracts contrary to perchloromethane-prompted toxic hepatitis in New Zealand albino rats. Res J Pharm Technol. 2021;14(7):3739-43. doi: 10.52711/0974-0360X.2021.00647
60. Chen WH, Bain A, Wang SY, Ho YC, Tzeng HY. Mediation of a mutualistic conflict for pollination via fig phenology and odor recognition between *Ficus* and fig wasp. Plants (Basel). 2022;11(19):2603. doi: 10.3390/plants11192603, PMID 36235469
61. Yang HW, Tzeng HY, Chou LS. Phenology and pollinating wasp dynamics of *Ficus microcarpa* L.f.: Adaptation to seasonality. Bot Stud. 2013;54(1):11. doi: 10.1186/1999-3110-54-11, PMID 28510855
62. Weiblen GD. Phylogenetic relationships of functionally dioecious *FICUS* (Moraceae) based on ribosomal DNA sequences and morphology. Am J Bot. 2000;87(9):1342-57. doi: 10.2307/2656726, PMID 10991904
63. Dong W, Xu C, Li C, Sun J, Zuo Y, Shi S, *et al*. ycf1, the most promising plastid DNA barcode of land plants. Sci Rep. 2015;5:8348. doi: 10.1038/srep08348, PMID 25672218
64. Gaur R, Chauhan A, Kanta C. Ethnomedicinal practices, bioactive constituents, and pharmacological applications of *Ficus religiosa* L. (Moraceae): A comprehensive and systematic review. Res J Pharm Technol. 2025;18(3):1410-8. doi: 10.52711/0974-360X.2025.00203
65. Pierantoni M, Tenne R, Rephael B, Brumfeld V, Van Casteren A, Kupczik K, *et al*. Mineral deposits in *Ficus* leaves: Morphologies and locations in relation to function. Plant Physiol. 2018;176(2):1751-63. doi: 10.1104/pp.17.01516, PMID 29242376
66. Sidhu MC, Sharma T. Antihyperglycemic activity of petroleum ether leaf extract of *Ficus krishnae* L. On alloxan-induced diabetic rats. Indian J Pharm Sci. 2014 Jul;76(4):323-31. doi: 10.4103/0250-474X.139850, PMID 25284930
67. Rahmani AH, Aldebasi YH. *Ficus carica* and its constituents role in management of diseases. Asian J Pharm Clin Res. 2017 Jun;10(6):

49-53. doi: 10.22159/ajpcr.2017.v10i6.17832
68. Tiwari P, Ranganathan N, Mahalingam GA. Antidiabetic activity of endophytic fungi isolated from *Ficus religiosa*. Asian J Pharm Clin Res. 2017 Apr 1;10(4):59-61. doi: 10.22159/ajpcr.2017.v10i4.14718
69. Singh Jassal PS, Sharma M. Evaluation of antioxidant, antibacterial, antihemolytic, and phytochemical properties of *Ficus benjamina*, *Ficus infectoria*, and *Ficus krishnae*. Asian J Pharm Clin Res. 2019;12(3): 68-73. doi: 10.22159/ajpcr.2019.v12i3.25351
70. Sasidharan SP, Yang X, Arunachalam K. An overview of ethnobotany, phytochemicals, and pharmacological properties of *Ficus* species. In: Arunachalam K, Yang X, Puthanpura S, editors. Bioprospecting of Tropical Medicinal Plants. Cham: Springer Nature Switzerland; 2023. p. 481-509. doi: 10.1007/978-3-031-28780-0_18
71. Majid GA, Hijazi MA, Ab EL, Ma E. Review on chemical constituents and biological activities of genus Juniper. Int J Pharm Pharm Sci. 2024;16(7):12-20. doi: 10.22159/ijpps. 2024v16i7.51144
72. Mazumder KA, Maji HS, Bala NN. Investigation of pharmacognostical, phytochemical, and pharmacological activity of aerial roots of *Ficus benghalensis* Linn. Asian J Pharm Clin Res. 2018;11(10):279-84. doi: 10.22159/ajpcr.2018.v11i10.27287
73. Nair AN, Nair RV, Nair AP, Nair AS, Thyagarajan S, Johnson AJ, *et al*. Antidiabetes constituents, cycloartenol and 24-methylenecycloartanol, from *Ficus krishnae*. PLOS One. 2020;15(6):e0235221. doi: 10.1371/journal.pone.0235221, PMID 32584888
74. Parveen M, Sohrab Khan M, Ilyas M. Chemical constituents of *Ficus krishnae*. J Indian Chem Soc. 1993;70(6):785-8.
75. Musapha Z, Harun H. Phytochemical constituents in leaves and callus of *Ficus deltoidea* Jack var. Kunstleri (King) Corner. Walailak J Sci Technol. 2015;12(5):431-9.
76. Badgujar SB, Patel VV, Bandivdekar AH, Mahajan RT. Traditional uses, phytochemistry and pharmacology of *Ficus carica*: A review. Pharm Biol. 2014;52(11):1487-503. doi: 10.3109/13880209.2014.892515, PMID 25017517
77. Wilson VA, Shetye SS, Kaur KA, Shetty SO. Study of synergistic effects on antioxidant activity and antimicrobial activity of polyherbal formulations containing *Ficus* species. Int J Pharm Pharm Sci. 2016;8(4):50-3.
78. Kanjikar AP, Londonkar RL. GC-MS analysis of bioactive compounds in petroleum ether extract of *Ficus krishnae*. Int Res J Pharm. 2017;8(10):178-81. doi: 10.7897/2230-8407.0810204
79. Hasnat H, Alam S, Akter Shompa SA, Saha T, Richi FT, Hossain MH, *et al*. Phyto-pharmacological wonders of genus *Ficus*: Ethnopharmacological insights and phytochemical treasures from natural products. Saudi Pharm J. 2024;32(12):102211. doi: 10.1016/j.jsps.2024.102211, PMID 39697478
80. Gilani AH, Mehmood MH, Janbaz KH, Khan AU, Saeed SA. Ethnopharmacological studies on antispasmodic and antiplatelet activities of *Ficus carica*. J Ethnopharmacol. 2008;119(1):1-5. doi: 10.1016/j.jep.2008.05.040, PMID 18586078
81. Hasnat H, Shompa SA, Islam MM, Alam S, Richi FT, Emon NU, *et al*. Flavonoids: A treasure house of prospective pharmacological potentials. Heliyon. 2024;10(6):e27533. doi: 10.1016/j.heliyon.2024.e27533, PMID 38496846
82. Kandav G, Bhatt DC, Jindal DK. Validation of HPLC method for the quantification of allopurinol in serum and kidney homogenates of mice. Res J Pharm Technol. 2020;13(1):373-6. doi: 10.5958/0974-360X.2020.00074.8
83. Agatonovic-Kustrin S, Wong S, Dolzhenko AV, Gegechkori V, Ku H, Tucci J, *et al*. Evaluation of bioactive compounds from *Ficus carica* L. Leaf extracts via high-performance thin-layer chromatography combined with effect-directed analysis. J Chromatogr A. 2023;1706:464241. doi: 10.1016/j.chroma.2023.464241, PMID 37541060
84. Jović MD, Agatonovic-Kustrin S, Ristivojević PM, Trifković JĐ, Morton DW. Bioassay-guided assessment of antioxidative, anti-inflammatory and antimicrobial activities of extracts from medicinal plants via high-performance thin-layer chromatography. Molecules. 2023;28(21):7346. doi: 10.3390/molecules28217346, PMID 37959765
85. Abraham A, Samuel S, Mathew L. Phytochemical analysis of Pathyashadangam kwath and its standardization by HPLC and HPTLC. J Ayurveda Integr Med. 2020 Apr 1;11(2):153-8. doi: 10.1016/j.jaim.2017.10.011, PMID 30446379
86. Govindan V, Shoba FG. Qualitative and quantitative determination of secondary metabolites and antioxidant potential of *Ficus benghalensis* Linn seed. Int J Pharm Pharm Sci. 2015;7(3):118-24.
87. Widowati WA, Gunanegara RF, Wargasetia TL, Kusuma HS, Arumwardana S, Wahyuni CD, *et al*. Effect of flavonoids on oxidative stress, apoptosis, and cell markers of peripheral blood-derived endothelial progenitor cells: An *in vitro* study. Int J Appl Pharm. 2021;13:39-42. doi: 10.22159/ijap.2021.v13s3.07
88. Parveen M, Ali A, Malla AM, Silva PS, Ramos Silva MR. A halogenated coumarin from *Ficus krishnae*. Chem Pap. 2011;65(5):735-8. doi: 10.2478/s11696-011-0055-9
89. Kumar S, Arif M, Kamal M, Jawaid T, Khan MM, Mukhtar B, *et al*. *Ex vivo* antiplatelet and thrombolytic activity of bioactive fractions from the new-fangled stem buds of *Ficus religiosa* l. With simultaneous GC-MS examination. Molecules. 2023;28(9):3918. doi: 10.3390/molecules28093918
90. Kanjikar AP, Londonkar RL. Isolation, purification and characterization of terpene from *Ficus krishnae*. Pharmacophore. 2020;11(2):30-5.
91. El-Beltagi HS, Mohamed HI, Abdelazeem AS, Youssef R, Safwat G. GC-MS analysis, antioxidant, antimicrobial and anticancer activities of extracts from *Ficus sycomorus* fruits and leaves. Not Bot Horti Agrobot Cluj-Napoca. 2018;47(2):493-505. doi: 10.15835/nbha47211405
92. Motghare AP, Katolkar PP, Chacherkar PA, Baheti JR. Flavones and their derivatives: Synthetic and pharmacological importance. Asian J Pharm Clin Res. 2022;15(7):25-34. doi: 10.22159/ajpcr.2022.v15i7.45190
93. Al Saiqali MA, Aziz SS, Reddy AV. Current status on phytochemicals classification, structure-activity relationship, stereochemistry and AI-driven applications: A systematic review. Pharmacogn Rev. 2025 Jul;19(38):186-211. doi: 10.5530/phrev.20252344
94. Elshafie HS, Camele I, Mohamed AA. A comprehensive review on the biological, agricultural and pharmaceutical properties of secondary metabolites based-plant origin. Int J Mol Sci. 2023 Feb 7;24(4):3266. doi: 10.3390/ijms24043266, PMID 36834673
95. Pujirahayu N, Bhattacharjya DK, Suzuki T, Katayama T. α-glucosidase inhibitory activity of cycloartane-type triterpenes isolated from Indonesian stingless bee propolis and their structure-activity relationship. Pharmaceuticals (Basel). 2019 Jul 1;12(3):102. doi: 10.3390/ph12030102, PMID 31266160
96. Liu K, Zhang X, Xie L, Deng M, Chen H, Song J, *et al*. Lupeol and its derivatives as anticancer and anti-inflammatory agents: Molecular mechanisms and therapeutic efficacy. Pharmacol Res. 2021 Feb;164:105373. doi: 10.1016/j.phrs.2020.105373, PMID 33316380
97. Claro-Cala CM, Grao-Cruces E, Toscano R, Millan-Linares MC, Montserrat-De La Paz S, Martin ME. Acyclic diterpene phytol from hemp seed oil (*Cannabis sativa* L.) exerts anti-inflammatory activity on primary human monocytes-macrophages. Foods. 2022 Aug 7;11(15):2366. doi: 10.3390/foods11152366, PMID 35954130
98. Alam MN, Bristi NJ, Rafiquzzaman M. Review on *in vivo* and *in vitro* methods evaluation of antioxidant activity. Saudi Pharm J. 2013;21(2):143-52. doi: 10.1016/j.jsps.2012.05.002, PMID 24936134
99. Sandhu AK, Islam M, Edirisinghe I, Burton-Freeman B. Phytochemical composition and health benefits of figs (fresh and dried): A review of literature from 2000 to 2022. Nutrients. 2023;15(11):2623. doi: 10.3390/nu15112623, PMID 37299587
100. Wati DP, Ilyas SY. Renoprotective potential of flavonoids-rich against doxorubicin-induced in animal models: A review. Int J App Pharm. 2024;16(6):28-37. doi: 10.22159/ijap.2024v16i6.51741
101. Bora RE, Khakhalary SE, Dutta TA. Phytochemical profiling, assessment of total phenolic content, total flavonoid content, and antioxidant activity of ethnomedicinal plant, *Meyna spinosa* from Assam. Asian J Pharm Clin Res. 2019;12(11):61-3. doi: 10.22159/ajpcr.2019.v12i11.34616
102. Lotha RO, Sivasubramanian AR. Flavonoids nutraceuticals in prevention and treatment of cancer: A review. Asian J Pharm Clin Res. 2018;11(1):42-7. doi: 10.22159/ajpcr.2017.v11i1.23410
103. Gupta MK, Kumar S, Chaudhary S. Coumarins: A unique scaffold with versatile biological behavior. Asian J Pharm Clin Res. 2019;12(3): 27-38. doi: 10.22159/ajpcr.2019.v12i3.30635
104. Gadamsetti S, Kamala G, Degala RP, Prasanna V, Yaswini K, Srilaya A. A review of synthesis and therapeutic applications of coumarin derivatives. J Pharma Insights Res. 2024;2(6):171-83. doi: 10.5281/zenodo.10439268
105. Alshibl HM, Al-Abdullah ES, Haiba ME, Alkahtani HM, Awad GE, Mahmoud AH, *et al*. Synthesis and evaluation of new coumarin derivatives as antioxidant, antimicrobial, and anti-inflammatory agents. Molecules. 2020;25(14):3251. doi: 10.3390/molecules25143251, PMID 32708787
106. Salehi B, Prakash Mishra A, Nigam M, Karazhan N, Shukla I, Kiełtyka-Dadasiewicz A, *et al*. *Ficus* plants: State of the art from a phytochemical, pharmacological, and toxicological perspective. Phytother Res. 2021;35(3):1187-217. doi: 10.1002/ptr.6884, PMID 33025667

107. Shamsudin NF, Ahmed QU, Mahmood S, Shah SA, Sarian MN, Khattak MM, *et al*. Flavonoids as antidiabetic and anti-inflammatory agents: A review on structure-activity relationship-based studies and meta-analysis. Int J Mol Sci. 2022;23(20):12605. doi: 10.3390/ijms232012605, PMID 36293459
108. Sarian MN, Ahmed QU, Mat So'ad SZ, Alhassan AM, Murugesu S, Perumal V, *et al*. Antioxidant and antidiabetic effects of flavonoids: A structure-activity relationship based study. BioMed Res Int. 2017;2017:8386065. doi: 10.1155/2017/8386065, PMID 29318154
109. Patwekar M, Patwekar F, Mezni A, Sanaullah S, Fatema SR, Almas U, *et al*. Assessment of antioxidative and Alpha-amylase potential of polyherbal extract. Evid Based Complement Alternat Med. 2022;2022:7153526. doi: 10.1155/2022/7153526, PMID 35685725
110. Abu T, Adedayo AJ, Luma WS, Ogbole OO. Potential antidiabetic effects by alpha-amylase inhibition and free radical scavenging activity of extracts from five medicinal plants used in Nigeria. Discov Plants. 2025;2(1):50. doi: 10.1007/s44372-025-00126-2
111. Zeng LR, Pan BW, Cai J, Liu LJ, Dong ZC, Zhou Y, *et al*. Construction, structural modification, and bioactivity evaluation of pentacyclic triterpenoid privileged scaffolds in active natural products. RSC Adv. 2024;14(53):39436-61. doi: 10.1039/D4RA07602H, PMID 39679419
112. Mohana Lakshmi S, Saravana Kumar A, Srikanth S, Tejo Vidyulatha K, Jyothi G, Mounica Choudari D, *et al*. Antidiabetic and antihyperlipidemic activity of *Ficus krishnae* L. In alloxan-induced diabetic rats. Pre Clin J. 2005;1(1):14-8.
113. Amorati R, Valgimigli L. Modulation of the antioxidant activity of phenols by non-covalent interactions. Org Biomol Chem. 2012;10(21):4147-58. doi: 10.1039/C2OB25174D, PMID 22505046
114. Ji W, Chen F, Chen Z, Jiang H. Research advances in the bioactivity of plant polyphenols. Int J Food Sci Technol. 2024;59(11):8037-44. doi: 10.1111/ijfs.17062
115. Hmidani A, Bouhlali ET, Ajebli M, Khouya T, Benlyas M, Alem C. *In vitro* investigation of antioxidant and antihemolytic activities of three *Lamiaceae* species from Morocco. Beni Suef Univ J Basic Appl Sci. 2021;10(1):27. doi: 10.1186/s43088-021-00116-9
116. Olasunkanmi AM, Ogunyemi O. Phytochemical constituents and antioxidant activity of *Persea americana* leave. Int J Chem Res. 2023;7(3):1-4. doi: 10.22159/ijcr
117. Malhotra M, Rana H, Tandon S. Exploring the therapeutic potential of *Catharanthus roseus*: Unveiling its diverse phytochemicals and mechanisms of action for chronic and infectious diseases. Int J Curr Pharm Res. 2024;16(5):1-8. doi: 10.22159/ijcpr.2024v16i5.5023
118. Wang Q, Zhang H, Jin Q, Wang X. Effects of dietary linoleic acid on blood lipid profiles: A systematic review and meta-analysis of 40 randomized controlled trials. Foods. 2023;12(11):2129. doi: 10.3390/foods12112129, PMID 37297374
119. Joshi DG, Jat DR, Patil DS. *In vitro* protein denaturation and membrane stabilising anti-arthritic activity of aqueous extracts of bark of *Ficus benghalensis* L. Against methotrexate. J Pharm Innov. 2021;10(4):689-92. doi: 10.22271/tpi.2021.v10.i4j.6038
120. Parvez A, Rahman MA, Rahman MM, Shimki AI, Ahmmed S, Supti FA, *et al*. Broad-spectrum therapeutic potentials of the multifaceted triterpene lupeol and its derivatives. Chem Biodivers. 2025;22(7):e202402286. doi: 10.1002/cbdv.202402286, PMID 39982855
121. Hawari D, Mutakin M, Wilar G, Levita J. Flavonoids of *Morus*, *Ficus*, and *Artocarpus* (Moraceae): A review on their antioxidant activity and the influence of climate on their biosynthesis. J Appl Pharm Sci. 2021;11(12):45-64. doi: 10.7324/JAPS.2021.1101203
122. Moreau RA, Whitaker BD, Hicks KB. Phytosterols, phytostanols, and their conjugates in foods: Structural diversity, quantitative analysis, and health-promoting uses. Prog Lipid Res. 2002;41(6):457-500. doi: 10.1016/S0163-7827(02)00006-1, PMID 12169300
123. Saleem M. Lupeol, a novel anti-inflammatory and anti-cancer dietary triterpene. Cancer Lett. 2009;285(2):109-15. doi: 10.1016/j.canlet.2009.04.033, PMID 19464787
124. Rice PA, Aungst J, Cooper J, Bandele O, Kabadi SV. Comparative analysis of the toxicological databases for 6:2 fluorotelomer alcohol (6:2 FTOH) and perfluorohexanoic acid (PFHxA). Food Chem Toxicol. 2020;138:111210. doi: 10.1016/j.fct.2020.111210, PMID 32087313
125. Duraisamy P, Angusamy A, Ravi S, Krishnan M, Martin LC, Manikandan B, *et al*. Phytol from Scoparia dulcis prevents NF-κB-mediated inflammatory responses during macrophage polarization. 3 Biotech. 2024;14(3):80. doi: 10.1007/s13205-024-03924-9.
126. Sandhu SS, Rouz SK, Kumar S, Swamy N, Deshmukh L, Hussain A, *et al*. Ursolic acid: A pentacyclic triterpenoid that exhibits anticancer therapeutic potential by modulating multiple oncogenic targets. Biotechnol Genet Eng Rev. 2023;39(2):729-59. doi: 10.1080/02648725.2022.2162257, PMID 36600517
127. Wang X, Zhang W, Yang Y, Wang J, Qiu H, Liao L, *et al*. A microRNA-based network provides potential predictive signatures and reveals the crucial role of PI3K/AKT signaling for hepatic lineage maturation. Front Cell Dev Biol. 2021;9:670059. doi: 10.3389/fcell.2021.670059, PMID 34141708
128. Feng Y, Ren Y, Zhang X, Yang S, Jiao Q, Li Q, *et al*. Metabolites of traditional Chinese medicine targeting PI3K/AKT signaling pathway for hypoglycemic effect in type 2 diabetes. Front Pharmacol. 2024;15:1373711. doi: 10.3389/fphar.2024.1373711, PMID 38799166
129. Chen B, Abaydula Y, Li D, Tan H, Ma X. Taurine ameliorates oxidative stress by regulating PI3K/Akt/GLUT4 pathway in HepG2 cells and diabetic rats. J Funct Foods. 2021;85:104629. doi: 10.1016/j.jff.2021.104629
130. Gandhi GR, Stalin A, Balakrishna K, Ignacimuthu S, Paulraj MG, Vishal R. Insulin sensitization via partial agonism of PPARγ and glucose uptake through translocation and activation of GLUT4 in PI3K/p-Akt signaling pathway by embelin in type 2 diabetic rats. Biochim Biophys Acta. 2013;1830(1):2243-55. doi: 10.1016/j.bbagen.2012.10.016, PMID 23104384
131. Mohammed A, Tajuddeen N, Ibrahim MA, Isah MB, Aliyu AB, Islam MS. Potential of diterpenes as antidiabetic agents: Evidence from clinical and pre-clinical studies. Pharmacol Res. 2022;179:106158. doi: 10.1016/j.phrs.2022.106158, PMID 35272043
132. Fang G, Cheng C, Zhang M, Ma X, Yang S, Hou X, *et al*. The glucuronide metabolites of kaempferol and quercetin, targeting the AKT PH domain, activate AKT/GSK3β signaling pathway and improve glucose metabolism. J Funct Foods. 2021;82:104501. doi: 10.1016/j.jff.2021.104501
133. Tang W, Liu H, Li X, Deng S, Gao C. Influence and treatment of insulin receptor substrate/PI3K/Akt-mediated insulin resistance in diabetes mellitus (review). Mol Med Rep. 2025;33(2):63. doi: 10.3892/mmr.2025.13773, PMID 41384289
134. Kulkarni A, Muralidharan C, May SC, Tersey SA, Mirmira RG. Inside the β cell: Molecular stress response pathways in diabetes pathogenesis. Endocrinology. 2022;164(1):bqac184. doi: 10.1210/endocr/bqac184, PMID 36317483
135. Cao X, Yang L, Xue Q, Yao F, Sun J, Yang F, *et al*. Antioxidant evaluation-guided chemical profiling and structure-activity analysis of leaf extracts from five trees in *Broussonetia* and *Morus* (Moraceae). Sci Rep. 2020;10(1):4808. doi: 10.1038/s41598-020-61709-5, PMID 32179776
136. González J, Cuéllar A, Nossin E, Monan M. Iron chelating activity of gossypitrin isolated from the petals of *Taliparititi elatum* Sw. (Fryxell) Malvaceae. J Agric Stud. 2017;5(1):56-67. doi: 10.5296/jas.v5i1.10677
137. Simunkova M, Barbierikova Z, Jomova K, Hudecova L, Lauro P, Alwasel SH, *et al*. Antioxidant vs. Prooxidant properties of the flavonoid, kaempferol, in the presence of Cu(II) ions: A ROS-scavenging activity, fenton reaction and DNA damage study. Int J Mol Sci. 2021;22(4):1619. doi: 10.3390/ijms22041619, PMID 33562744
138. Sin MH, Mamat AS, Aslam MS, Ahmad MS. Total phenolic content and antioxidant potential of *Ficus deltoidea* using green and non-green solvents. J Pharm Negat Results. 2017;8(1):15-9. doi: 10.4103/0976-9234.204913
139. Stachelska MA, Karpiński P, Kruszewski B. A comprehensive review of biological properties of flavonoids and their role in the prevention of metabolic, cancer and neurodegenerative diseases. Appl Sci. 2025;15(19):10840. doi: 10.3390/app151910840
140. Rajan P, Natraj P, Ranaweera SS, Dayarathne LA, Lee YJ, Han CH. Anti-adipogenic effect of flavonoids through activation of AMPK in palmitate-treated HepG2 cells. J Vet Sci. 2021;23(1):e4. doi: 10.4142/jvs.2022.e4
141. Mahboob A, Samuel SM, Mohamed A, Wani MY, Ghorbel S, Miled N, *et al*. Role of flavonoids in controlling obesity: Molecular targets and mechanisms. Front Nutr. 2023;10:1177897. doi: 10.3389/fnut.2023.1177897, PMID 37252233
142. Xue P, You X, Ren L, Yue W, Ma Z. PPARγ-mediated amelioration of lipid metabolism abnormality by kaempferol. Arch Biochem Biophys. 2024;761:110154. doi: 10.1016/j.abb.2024.110154, PMID 39278305
143. Dalimunthe A, Carensia Gunawan M, Dhiya Utari Z, Dinata MR, Halim P, Pakpahan NE, *et al*. In-depth analysis of lupeol: Delving into the diverse pharmacological profile. Front Pharmacol. 2024;15:1461478. doi: 10.3389/fphar.2024.1461478, PMID 39605919
144. Altunayar-Unsalan C. DSC and FTIR study on the interaction between pentacyclic triterpenoid lupeol and DPPC membrane. J Bioenerg Biomembr. 2024;56(5):553-61. doi: 10.1007/s10863-024-10030-1,

PMID 38918323
145. Pereira Beserra F, Xue M, Maia GL, Leite Rozza A, Helena Pellizzon C, Jackson CJ. Lupeol, a pentacyclic triterpene, promotes migration, wound closure, and contractile effect *in vitro*: Possible involvement of PI3K/Akt and p38/ERK/MAPK pathways. Molecules. 2018;23(11):2819. doi: 10.3390/molecules23112819, PMID 30380745
146. Prakash VE. Terpenoids as source of anti-inflammatory compounds. Asian J Pharm Clin Res. 2017;10(3):68-76. doi: 10.22159/ajpcr.2017.v10i3.16435
147. Lee YS, Kwon RJ, Lee HS, Chung JH, Kim YS, Jeong HS, *et al*. The role of pentacyclic triterpenoids in non-small cell lung cancer: The mechanisms of action and therapeutic potential. Pharmaceutics. 2024;17(1):22. doi: 10.3390/pharmaceutics17010022, PMID 39861671
148. Han Y, Yuan C, Zhou X, Han Y, He Y, Ouyang J, *et al*. Anti-inflammatory activity of three triterpene from *Hippophae rhamnoides* L. In lipopolysaccharide-stimulated RAW264.7 cells. Int J Mol Sci. 2021;22(21):12009. doi: 10.3390/ijms222112009, PMID 34769438
149. Gopukumar ST, Praseetha PK. *Ficus benghalensis Linn*-the sacred Indian medicinal tree with potent pharmacological remedies. Int J Pharm Sci Rev Res. 2015;32(1):223-7.
150. Oboh M, Govender L, Siwela M, Mkhwanazi BN. Anti-diabetic potential of plant-based pentacyclic triterpene derivatives: Progress made to improve efficacy and bioavailability. Molecules. 2021;26(23):7243. doi: 10.3390/molecules26237243, PMID 34885816
151. Teng W, Zhou Z, Cao J, Guo Q. Recent advances of natural pentacyclic triterpenoids as bioactive delivery system for synergetic biological applications. Foods. 2024;13(14):2226. doi: 10.3390/foods13142226, PMID 39063310
152. Pedgaonkar A, Adithya GM, Reddy PS, Thanuja K, Divyashree L, Bakshi V, *et al*. Assessment of anti-oxidant activity of *Ficus benghalensis* leaves: An *in-vitro* design. J Drug Deliv Ther. 2019;9(2):20-4. doi: 10.22270/jddt.v9i2.2366
153. Zhong R, Miao L, Zhang H, Tan L, Zhao Y, Tu Y, *et al*. Anti-inflammatory activity of flavonols via inhibiting MAPK and NF-κB signaling pathways in RAW264.7 macrophages. Curr Res Food Sci. 2022;5:1176-84. doi: 10.1016/j.crfs.2022.07.007, PMID 35941847
154. Banerjee J, Samanta S, Ahmed R, Dash SK. Bioactive pentacyclic triterpenes trigger multiple signalling pathways for selective apoptosis leading to anticancer efficacy: Recent updates and future perspectives. Curr Protein Pept Sci. 2023;24(10):820-42. doi: 10.2174/1389203724666230418123409, PMID 37073661
155. Fontanay S, Grare M, Mayer J, Finance C, Duval RE. Ursolic, oleanolic and betulinic acids: Antibacterial spectra and selectivity indexes. J Ethnopharmacol. 2008;120(2):272-6. doi: 10.1016/j.jep.2008.09.001, PMID 18835348
156. Kumari S, Sharma A, Yadav S. Novel coumarin chalcone derivatives: Synthesis, docking, and antimicrobial evaluation. J Appl Pharm Res. 2025;13(1):62-74. doi: 10.69857/joapr.v13i1.838
157. Dawood DH, Batran RZ, Farghaly TA, Khedr MA, Abdulla MM. New coumarin derivatives as potent selective COX-2 inhibitors: Synthesis, anti-inflammatory, QSAR, and molecular modeling studies. Arch Pharm (Weinheim). 2015;348(12):875-88. doi: 10.1002/ardp.201500274, PMID 26462142
158. Sharma S, Singh R, Singh K, Singh S. Coumarins and their derivatives as anti-inflammatory agents. In: Bendi A, Kaushik MP, Raghav N, editors. Heterocyclic Anti-Inflammatory Agents: A Guide for Medicinal Chemists. United Arab: Bentham Science Publishers; 2024. p. 208-30. doi: 10.2174/9789815223460124010013
159. Matos MJ, Santana L, Uriarte E, Abreu OA, Molina E, Yordi EG. Coumarins-an important class of phytochemicals. Phytochemicals-isolation, characterisation and role in Hum Health. 2015;25:533-8.
160. Islam MT, Ali ES, Uddin SJ, Shaw S, Islam MA, Ahmed MI, *et al*. Phytol: A review of biomedical activities. Food Chem Toxicol. 2018;121:82-94. doi: 10.1016/j.fct.2018.08.032, PMID 30130593
161. Carvalho AM, Heimfarth L, Pereira EW, Oliveira FS, Menezes IR, Coutinho HD, *et al*. Phytol, a chlorophyll component, produces antihyperalgesic, anti-inflammatory, and antiarthritic effects: Possible NFκB pathway involvement and reduced levels of the proinflammatory cytokines TNF-α and IL-6. J Nat Prod. 2020;83(4):1107-17. doi: 10.1021/acs.jnatprod.9b01116, PMID 32091204
162. Kim EN, Trang NM, Kang H, Kim KH, Jeong GS. Phytol suppresses osteoclast differentiation and oxidative stress through Nrf2/HO-1 regulation in RANKL-induced RAW264.7 cells. Cells. 2022;11(22):3596. doi: 10.3390/cells11223596, PMID 36429027
163. Fouche G, Cragg GM, Pillay P, Kolesnikova N, Maharaj VJ, Senabe J. *In vitro* anticancer screening of South African plants. J Ethnopharmacol. 2008;119(3):455-61. doi: 10.1016/j.jep.2008.07.005, PMID 18678239
164. Cabanlit KL, Torres MA, Demayo CG. *Ficus spp.* (Figs) and their anticancer potential: A systematic review of laboratory studies and traditional uses in the Philippines. J HerbMed Pharmacol. 2025;14(2):133-52. doi: 10.34172/jhp.2025.52854
165. Usman M, Khan WR, Yousaf N, Akram S, Murtaza G, Kudus KA, *et al*. Exploring the phytochemicals and anti-cancer potential of the members of Fabaceae family: A comprehensive review. Molecules. 2022;27(12):3863. doi: 10.3390/molecules27123863, PMID 35744986
166. Kanjikar AP, Hugar AL, Londonkar RL. Characterization of phyto-nanoparticles from *Ficus krishnae* for their antibacterial and anticancer activities. Drug Dev Ind Pharm. 2018;44(3):377-84. doi: 10.1080/03639045.2017.1386205, PMID 29098876
167. Thamaraikani V, Amala SD, Sekar T. Analysis of the phytochemicals, antioxidants, and antimicrobial activity of *Ficus tsjahela* Burm. F leaf, bark, and fruit extracts. Asian J Pharm Clin Res. 2021;14(2):54-9. doi: 10.22159/ajpcr.2021v14i2.40185
168. Sugasini P, Mahalakshmi V, Muthukumar NJ. A review of a single herbal plant used for antidiabetic activity in Siddha materia medica. Res J Pharm Technol. 2024;17(5):2421-6. doi: 10.52711/rjpt.2024.2421
169. Kumar YS, Lakshmi OS, Selvam NT, Vasanthakumar KG, Deep VC, Ala S, *et al*. Antidiabetic activity of *Ficus gibbosa* Blume extracts in streptozotocin-nicotinamide-induced diabetes in Sprague Dawley rats. J Drug Res Ayurvedic Sci. 2020;5(1):57-62. doi: 10.5005/jdras-10059-0094
170. Prasanth DS, Pasala PK, Yaraguppi DA, Khan J, Rudrapal M. Antidiabetic potential of *Ficus septica* targeting aldose reductase and glycogen synthase kinase 3β. Pharmacol Res Nat Prod. 2025;9:100440. doi: 10.1016/j.prenap.2025.100440
171. Subhash S, Manisha S, Kamble RB, Choudhary RR. Antibacterial activity of *Ficus benghalensis* var. Krishnae (C. DC.) C. DC. Against pathogenic bacterial strains. Sciences. 2016;6:43-6.
172. Pingale T, Duse P, Ogale S. Antibacterial and antifungal approaches of *Ficus racemosa*. Pharmacogn J. 2019;11(2):355-7. doi: 10.5530/pj.2019.11.53
173. Kumaresan SU, Ramasamy RE, Jayachandran PR. Antioxidant and cytotoxic activity of combined extracts prepared using *Ficus religiosa* and *Ficus benghalensis* leaves against cervical cancer cell line (hela). Asian J Pharm Clin Res. 2018;11(12):407-10. doi: 10.22159/ajpcr.2018.v11i12.26948
174. Kanjikar AP, Aruna LH, Londonkar RL. A novel investigation of *in-vitro* anti-inflammatory and antioxidant activity of *Ficus krishnae*. Eur J Biomed PharmSci. 2017;4(10):313-7.
175. Sánchez-Valdeolívar CA, Alvarez-Fitz P, Zacapala-Gómez AE, Acevedo-Quiroz M, Cayetano-Salazar L, Olea-Flores M, *et al*. Phytochemical profile and antiproliferative effect of *Ficus crocata* extracts on triple-negative breast cancer cells. BMC Complement Med Ther. 2020 Jun 22;20(1):191. doi: 10.1186/s12906-020-02993-6, PMID 32571387
176. Haldar KM, Ghosh P, Chandra G. Larvicidal, adulticidal, repellency and smoke toxic efficacy of *Ficus krishnae* against *Anopheles stephensi* Liston and *Culex vishnui* group mosquitoes. Asian Pac J Trop Dis. 2014 Jan 1;4 Suppl 1:S214-20. doi: 10.1016/S2222-1808(14)60442-4
177. Kanjikar A. Novel investigation on *in-vitro* anti-diabetic and volatile profile of bioactive compounds present in methanolic extract of *Ficus krishnae*. Int J Pharm Clin Res. 2017;9(10):642-4.
178. Chen L, Cao H, Huang Q, Xiao J, Teng H. Absorption, metabolism and bioavailability of flavonoids: A review. Crit Rev Food Sci Nutr. 2022 Oct 3;62(28):7730-42. doi: 10.1080/10408398.2021.1917508, PMID 34078189
179. Zhao J, Yang J, Xie Y. Improvement strategies for the oral bioavailability of poorly water-soluble flavonoids: An overview. Int J Pharm. 2019 Oct 30;570:118642. doi: 10.1016/j.ijpharm.2019.118642, PMID 31446024
180. Yuan D, Guo Y, Pu F, Yang C, Xiao X, Du H, *et al*. Opportunities and challenges in enhancing the bioavailability and bioactivity of dietary flavonoids: A novel delivery system perspective. Food Chem. 2024 Jan 1;430:137115. doi: 10.1016/j.foodchem.2023.137115, PMID 37566979