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A systematic review on phytochemical profile and pharmacological activities of *Ficus infectoria* (Roxb.)

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Abstract
Ficus infectoria (Roxb.) is an Indian medicinal plant, which is commonly known as 'white fig'. The plant belongs to the family 'Moraceae'. Traditional medicine systems have been utilized plants for centuries to treat various diseases and disorders. The aim of this study was to review the phytochemical profile and pharmacological activities of medicinal plant *Ficus infectoria* (Roxb.). The various bio-active phytochemical constituents, such as flavonoids, phenolic compounds, tannins, saponins, terpenoids, glycosides, carbohydrates, alkaloids, proteins and amino acids have been identified in this plant. The various extracts of aerial parts of this plant have been evaluated for their hepato-protective, anti-bacterial, neuro-protective, anti-oxidant, anti-diabetic, anti-inflammatory, anti-filarial and anthelmintic activities. Henceforth, the results have been shown that, the ethanolic fruit extract has been exhibited maximum inhibitory activity against methanolic fruit extract, while maximum anti-bacterial activity have been shown in methanolic leaves extract, as compared to acetonic and aqueous leaves extracts. Both aqueous and alcoholic fruits extracts have been exhibited minimum anti-oxidant activity against standard drug. In conclusion, the present study has been focused to review the phytochemical profile and pharmacological activities of medicinal plant *Ficus infectoria* (Roxb.). It has been concluded that, the aerial parts of this plant extracts can be used to treat Human ailments.

Keywords: *Ficus infectoria* (Roxb.), white fig, phytochemical profile, pharmacological activities

Introduction

The World Health Organization (WHO) defines traditional medicine as the total of the knowledge, skill and practices, which is based upon the theories, beliefs and experiences indigenous to different cultures, whether used in the maintenance of health as well as in the diagnosis, prevention and treatment of physical and mental illness. The WHO estimates that, approximately 80% of the population living in developing countries which depends on traditional medicine for their prime healthcare needs. Medicinal herbs play a vital role and comprise the backbone of traditional medicines [1].

Disease and health are two chief factors that go simultaneously. Approximately, 75-95% of world's population still relys on plants for the treatment of diseases and disorders or as primary source for healthcare [2]. India is referred as the botanical garden of the world and holds the largest resources of Indian medicinal plants, benefited from a diverse range of agro-climatic conditions. According to scientific reports, herbal remedies have served a significant source of medications for the treatment and prevention of various diseases and disorders over the centuries [3]. Plants have played a vital role in maintaining Human health and improving the quality of Human life for thousands of years. Plants have served Humans as well as valuable components of medicines, seasonings, beverages, cosmetics and dyes. Herbal medicine is based on the premise that plants contain natural substances that can promote health and alleviate illness [4]. Indian medicinal plants are gaining importance in the fields of scientific research. Medicinal plants originate from almost every part of the world [5].

The Moraceae family is one of the largest families among angiosperms, comprising 73 genera and 1100 species worldwide of trees, shrubs, climbers and herbs. Several members of the genus *Ficus* have a wide variety of medicinal uses all over the world [6].

The genus *Ficus* is commonly known as figs. It is one of the largest plant genera with over 800 diverse species of trees and shrubs found in tropical and sub-tropical areas of the world. Figs plants are one of the preferred nutritional sources to be cultivated for Human purpose and have been grown for over 1100 years. *Ficus* is culturally and ecologically significant and it's still the focus of scientific research in domains ranging from agriculture to ecology and medicine [7].

The Indian medicinal plant *Ficus infectoria* (Roxb.) is commonly known as 'white fig or white-fruited wavy leaf fig tree'. It belongs to the family 'Moraceae'. It is a monoecious, large perennial, spreading, huge deciduous and fast-growing closely foliaceous tree. It is dispersed in tropical and sub-tropical climates across the world. It is widely distributed in India, Myanmar, Bhutan, Nepal, Southeast Asia, Burma, Indochina and Australia. It is one such Indian medicinal plant, which has been used in traditional system of medicine such as Ayurveda and Unani for the treatment of ulcers and gastric ulcer. A stem bark is used as a wash for ulcers and as an injection in leucorrhoea. Milky latex of stem is used for the treatment of typhoid and dysentery. A decoction of bark is used as a gargle in salivation. The aerial parts of the plant contain diverse pharmacological studies such as wound healing and anti-oxidant activities [8].

Botanical description of plant:

Taxonomical Classification [9, 10]:

Botanical name: *Ficus infectoria* (Roxb.).

Synonyms: *Ficus lacor* Buch.Ham, *Ficus lucescens* Blume, *Ficus virens*.

Common names: Spotted white fig, pilkhan, sacred fig tree.

Domain: Eukaryota.

Kingdom: Plantae (Plants).

Sub-kingdom: Tracheobiota (Vascular plants).

Phylum: Tracheophyta.
Division: Magnoliophyta (Flowering plants).
Super-division: Spermatophyta (Seed plants).
Class: Magnoliopsida (Dicotyledons).
Sub-class: Hamamelidae.
Order: Rosales.
Family: Moraceae.
Tribe: Ficeae.
Genus: *Ficus*
Species: *Ficus infectoria* (Roxb.).

Vernacular Names [9, 10]:
Kannada: Basseri, juvvi, karibassari.
Hindi: Kahimal, kaim, koel, pilkhan, pakar.
Sanskrit: Plaksha.
Marathi: Bassari, dhedumbara, gandhaumbara.
Tamil: Jovi, kallal, suvi, kurugatti.
Telugu: Badijuvvi, jati.
Bengali: Pakar, pakur.
Malayalam: Bakri, chakkila, chela.
Urdu: Pakodo.
Gujarati: Pipli, pipri.

Morphology [9, 10]:
Plant: *Ficus infectoria* (Roxb.) is a plant species that belongs to the Moraceae family. It is commonly known as 'white fig'. It is a monoecious, large perennial, spreading, huge deciduous, fast-growing closely foliaceous trees and epiphytic in young stages, with a few aerial roots. Stem bark is rough, scaly and dark grey coloured. All parts of the plant are acrid, pungent and cooling.

Geographical Distribution: It is distributed in Kerebilchi, Nanjungud, Mysore, Shivamogga, Mangalore, Dharwad, Hassan, Karnataka, Maharashtra, New Delhi, Uttar Pradesh, Chandigarh, Kerala, Tamil Nadu, Sikkim, West Bengal, Assam, India, Japan, Bangladesh, Nepal, Sri Lanka, Southwest China, Indochina, Northern Australia, Malaysia, Bhutan, Myanmar and Burma.

Leaves: The leaves are membranous, coriaceous, glabrous, ablong ovate-lanceolate, abrupt shortly acuminate with entire sub-undulate margins; base usually rounded, slightly subcordate or truncate, narrowed or acute; petioles are 3.8-5.7cm long, indistinctly joined with the blade; stipules about 13mm long broadly ovate, acute, pubescent, receptacles axillary in pairs, unisexual, sessile and globose.

Flowers: The male flowers are sessile near the mouth of the receptacles. Stamen is 1; anther broadly ovate; filament is short. Sepals are 4 to 5: perianth as in the male. Style of fertile female flowers are long and stigma elongate.

Fruits: The fruits are sour in taste, axillary in pairs, sessile, globose, whitish colour, when ripe and flushed, when red and dotted.

Fig 1: Leaves

Fig 2: Fruits

Fig 1 & 2: Photograph showing the leaves and fruits of *Ficus infectoria* (Roxb.) plant

Fig 3: Photograph showing the whole tree of *Ficus infectoria* (Roxb.) plant

Medicinal Uses [9-12]:
The aerial parts of the plant *Ficus infectoria* (Roxb.) contains diverse pharmacological activities such as anti-diabetic, anti-protozoal, anti-asthmatic, anti-inflammatory, anti-hemolytic, anti-fungal, anti-bacterial, anti-ulcer, anti-convulsant, analgesic, anti-hyperlipidemic, anthelmintic, anti-diarrheal, anti-viral, wound healing, anti-filarial, astringent, antiseptic, anti-diuretic, anti-arthritic, cardio-protective, hepato-protective and immunomodulatory activities.

Traditional Uses [9-12]:
Ficus infectoria (Roxb.) plant has been used in traditional system of medicine such as Ayurveda and Unani for the treatment of ulcers, gastric ulcer, skin ulcer, warts, bone fracture, leprosy, tuberculosis, rheumatism, hallucinations, wounds, gastric problems, vertigo, edema, delirium, hay fever, dysentery, diarrhea, inflammation, apoplexy, epitaxis, erysipelas, burning sensation, acne, typhoid, blisters, biliousness, bronchitis, skin diseases, pain, mental disorders, uterine disorders, menstrual disorders, gynecological disorders, neuropsychiatric disorders, stomach disorders, blood diseases and vaginal diseases. A decoction of stem bark is used as a gargle in salivation, as a wash for ulcers and as an injection in leucorrhea.

Phytochemistry [9-12]:
The aerial parts of the plant *Ficus infectoria* (Roxb.) contains bio-active phytochemical constituents, such as flavonoids, phenolic compounds, tannins, saponins, steroids, triterpenoids, glycosides, carbohydrates, alkaloids, proteins and amino acids.

Phytochemical constituents of the leaves:
The leaves of the plant *Ficus infectoria* (Roxb.) contains flavonoids (quercetin, kaempferol), phenolic compounds (protocatechuic acid), tannins, saponins, carotenoids, steroids, triterpenoids (lanosterol, oleanolic acid, maslinic acid, ursolic acid, α-hydroxy ursolic acid, α-amyrin, β-amyrin, lupeol), phytosterols (campesterol, β-sitosterol, stigmasterol, bergapten, bergaptol), glycosides (sorbifolin), carbohydrates, alkaloids, proteins and amino acids.

Phytochemical constituents of the stem bark:
The stem bark contains flavonoids, phenolic compounds (proanthocyanidin, leucoanthocyanidin, caffeic acid), tannins, saponins, steroids, terpenoids, diterpenoids, triterpenoids (lanosterol), phytosterols (β-sitosterol, stigmasterol, bergapten, bergaptol, bergenin), glycosides, alkaloids, carbohydrates (lactose, fructose, sucrose, galactose), enzymes (tyrosinase), proteins, amino acids (ornithine, alanine, tyrosine, methionine), fibers (acid detergent fiber, neutral detergent fiber), gums, mucilage, resins, volatile oils and anti-oxidants (vitamin-A, vitamin-C, vitamin-E).

Phytochemical constituents of the fruits:
The fruits contain flavonoids, phenolic compounds (proanthocyanidin), tannins, saponins, steroids, triterpenoids, phytosterols, glycosides, carbohydrates, alkaloids, proteins, enzymes (tyrosinase) and amino acids (tyrosine, asparagine).

Phytochemical constituents of the seeds:
The seeds contain flavonoids, phenolic compounds, tannins, saponins, steroids, triterpenoids, phytosterols, glycosides, carbohydrates, alkaloids, proteins and amino acids (ornithine, alanine, threonine, methionine, tyrosine).

Table 1: The complete summary of phytochemical properties of *Ficus infectoria* (Roxb.) [9-12]

Sl. No.	Plant parts used	Phytochemical constituents	Chemical name	Ethnomedicinal importance
01.	Leaves	Flavonoids, Phenolic compounds, Tannins, Phytosterols, Triterpenoids.	Quercetin, Kaempferol, Lanosterol, Bergenin, β-sitosterol, Stigmasterol, Bergapten, Bergaptol.	Anti-diabetic, Hepato-protective, Wound healing, Anti-oxidant, Anti-inflammatory.
02.	Stem bark	Phenolic compounds, Phytosterols, Triterpenoids, Flavonoids, Tannins.	Proanthocyanidin, Lanosterol, Bergenin, β-sitosterol, Stigmasterol, Bergapten, Bergaptol, Bergenin.	Anti-diabetic, Anti-microbial, Wound healing, Anti-inflammatory.
03.	Fruits	Phenolic compounds, Flavonoids, Tannins.	Proanthocyanidin, Quercetin, Kaempferol.	Anti-diabetic, Anti-oxidant.

Diverse species of genus *Ficus* [10, 13]:
Ficus infectoria Roxb, *Ficus benghalensis* Linn, *Ficus carica* Linn, *Ficus glomerata* Roxb, *Ficus hispida* Linn, *Ficus thonningii* Blume, *Ficus decora*, *Ficus cycomorous*, *Ficus hawaii*, *Ficus retusa*, *Ficus platyphylla*, *Ficus religiosa* Linn, *Ficus benjamina*, *Ficus krishnae*, *Ficus racemosa* Willd, *Ficus deltoidei* Jack, *Ficus natalensis*, *Ficus auriculata* Lour, *Ficus exasperata*, *Ficus fistulosa*, *Ficus pumila*, *Ficus ampelas*, *Ficus villosa* Blume, *Ficus microcarpa*, *Ficus rumphii* Blume, *Ficus maclellandii*, *Ficus consociata* Blume, *Ficus glabella*, *Ficus copiosa*, *Ficus montana*, *Ficus vasculosa* Wall, *Ficus glandulifera* Jack, *Ficus padana* Burm, *Ficus hirta* Vahl, *Ficus palmata* Forssk, *Ficus erecta* Thunb, *Ficus variegata* Blume, *Ficus pumila*, *Ficus sagittata* Vahl, *Ficus drupacea* Thunb, *Ficus nervosa* Roth, *Ficus coronata* Spin, *Ficus obscura* Blume, *Ficus sinuata* Thunb, *Ficus septica* Burm, *Ficus binnendijkii* Miq, *Ficus elastica* Roxb, *Ficus lyrata* Warb, *Ficus parietalis* Blume, *Ficus fistulosa* and *Ficus lepicarpa* Blume.

Pharmacological activities

1. Hepato-protective activity:
The methanolic extract of fresh leaves and barks of *Ficus infectoria* (Roxb.) has been investigated for their hepato-protective activity against paracetamol induced liver damage in wistar albino rats. This study has been confirmed and reported that, the methanolic extract of fresh leaves and barks of *Ficus infectoria* (Roxb.) has been exhibited the significant hepato-protective potential effect against paracetamol induced liver damage in wistar albino rats, as compared to standard drug (silymarin) respectively [14].

2. Anti-bacterial activity:
The methanolic, acetonic and aqueous extracts of *Ficus infectoria* (Roxb.) leaves have been evaluated for their anti-

bacterial activity against bacterial strain of Staphylococcus aureus by using an agar well diffusion method. It has been revealed that, the methanolic extract of *Ficus infectoria* (Roxb.) leaves has been shown a maximum zone of inhibition of 30.5mm against bacterial strain of Staphylococcus aureus, as compared to acetonic and aqueous extracts of *Ficus infectoria* (Roxb.) leaves. Henceforth, it has been reported that, the methanolic extract of *Ficus infectoria* (Roxb.) leaves has been exhibited the maximum anti-bacterial potential effect against bacterial strain of Staphylococcus aureus, as compared to acetonic and aqueous extracts of *Ficus infectoria* (Roxb.) leaves [15].

3. Neuro-protective activity:

The methanolic and ethanolic extracts of *Ficus infectoria* (Roxb.) fruits have been screened for their neuro-protective activity against scopolamine induced memory impairment in male albino mice by using passive avoidance approach method. It has been revealed that, the ethanolic extract of *Ficus infectoria* (Roxb.) fruits has been exhibited the maximum neuro-protective potential effect against scopolamine induced memory impairment in male albino mice, as compared to methanolic extract of *Ficus infectoria* (Roxb.) fruits [16].

4. Phytochemical constitution of various extracts of leaves and barks of *Ficus infectoria* (Roxb.):

The present study has been subjected for their preliminary phytochemical investigation of methanolic, ethanolic, chloroform and aqueous extracts of leaves and barks of *Ficus infectoria* (Roxb.). It has been revealed that, the phytochemical screening of methanolic, ethanolic, chloroform and aqueous extracts of leaves and barks of *Ficus infectoria* (Roxb.) have been shown the bio-active phytochemical constituents, such as flavonoids, tannins, phenolic compounds, saponins, glycosides, alkaloids, carbohydrates, phytosterols, proteins and amino acids by positive reaction with the respective test reagent. Henceforth, it has been reported that, the phytochemical analysis has been shown the maximum presence of phytoconstituents, such as flavonoids, tannins, phenolic compounds, saponins, glycosides, alkaloids, carbohydrates, phytosterols, proteins and amino acids present in the methanolic and ethanolic extracts of leaves and barks of *Ficus infectoria* (Roxb.), as compared to chloroform and aqueous extracts of leaves and barks of *Ficus infectoria* (Roxb.) [17].

5. Anti-oxidant activity:

The alcoholic and aqueous extracts of *Ficus infectoria* fruits have been determined for their *in-vitro* anti-oxidant activity against standard drug (ascorbic acid) by using both reducing power and hydrogen peroxide scavenging assays. It has been revealed that, the highest concentration of 500µg/mL of both alcoholic and aqueous extracts of *Ficus infectoria* fruits have been shown the minimum reducing power scavenging potency of 1.054% and 0.978%, as compared to standard drug (ascorbic acid) by using reducing power scavenging assay respectively. Similarly, the highest concentration of 1000µg/mL of both alcoholic and aqueous extracts of *Ficus infectoria* fruits have been shown the minimum hydrogen peroxide scavenging potency of 78.41% and 61.25%, as compared to standard drug (ascorbic acid) by using hydrogen peroxide scavenging assay respectively. Hence, it has been reported that, both alcoholic and aqueous extracts of *Ficus infectoria* fruits have been exhibited the minimum percentage inhibition of scavenging potential effect against standard drug (ascorbic acid) by using both reducing power and hydrogen peroxide scavenging assays respectively. Henceforth, both alcoholic and aqueous extracts of *Ficus infectoria* fruits have been exhibited the minimum anti-oxidant property in dose-dependent manner, as compared to standard drug (ascorbic acid) by using both reducing power and hydrogen peroxide scavenging assays respectively [18].

6. Anti-filarial activity:

The alcoholic and aqueous extracts of *Ficus infectoria* (Roxb.) leaves have been evaluated for their *in-vitro* anti-filarial activity against cattle parasite Setaria cervi for its spontaneous movements of both whole worm and nerve muscle preparation. It has been revealed that, the concentrations required to inhibit the spontaneous movements of both whole worm and nerve muscle preparation of Setaria cervi for the alcoholic extract of *Ficus infectoria* (Roxb.) leaves has been found to be 150µg/mL and 30µg/mL respectively. Similarly, the concentrations required to inhibit the spontaneous movements of both whole worm and nerve muscle preparation of Setaria cervi for the aqueous extract of *Ficus infectoria* (Roxb.) leaves has been found to be 260µg/mL and 130µg/mL respectively, suggesting a cuticular barrier restriction. It has been reported that, the lethal alcoholic extract concentration (LC_{50} and LC_{90}=10 and 21ng/mL) has been shown more potent effect, as compared to lethal aqueous extract concentration (LC_{50} and LC_{90}=14 and 26ng/mL), suggesting effective tool for filariasis. Henceforth, both alcoholic and aqueous extracts of *Ficus infectoria* (Roxb.) leaves have been exhibited the significant anti-filarial potential effect against cattle parasite Setaria cervi [19].

7. Anthelmintic activity:

The petroleum ether, chloroform, ethanol and aqueous extracts of *Ficus lacor* Buch.Ham barks have been investigated for their anthelmintic activity against Eisenia fetida earthworm. It has been revealed and reported that, the concentration of 150mg/mL of both ethanol and chloroform extracts of *Ficus lacor* Buch.Ham barks have been shown more efficient than standard drug piperazine citrate (10mg/mL), as compared to both aqueous and petroleum ether extracts of *Ficus lacor* Buch.Ham barks by causing paralysis and death of earthworms, indicating their efficacy in helminthiasis. Henceforth, all the extracts of *Ficus lacor* Buch.Ham barks have been exhibited the dose-dependent anthelmintic potential effect against Eisenia fetida earthworm [20].

8. Anti-diabetic activity:

The ethanolic extract of fruits and cork of *Ficus lacor* Buch.Ham have been evaluated for their *in-vivo* anti-diabetic activity against streptozocin (STZ) induced diabetic adult female wistar rats. It has been reported that, the ethanolic extract of *Ficus lacor* Buch.Ham fruits have been exhibited the maximum hypoglycemic potential effect against streptozocin (STZ) induced diabetic adult female wistar rats, as compared to ethanolic extract of *Ficus lacor* Buch.Ham cork [21].

9. Anti-inflammatory activity:

The methanolic extract of *Ficus virens* barks has been screened for their *in-vitro* anti-inflammatory activity against both heat induced hemolytic method and egg albumin protein denaturation method respectively. It has been suggested and reported that, the methanolic extract of *Ficus virens* barks has been exhibited the maximum percentage inhibitory potential effect against heat induced hemolytic method, as compared to standard drug (aspirin) respectively. Similarly, the methanolic extract of *Ficus virens* barks has been exhibited the significant percentage inhibitory potential effect against egg albumin protein denaturation method, as compared to standard drug (diclofenac sodium) respectively. Henceforth, the various concentrations of methanolic extract of *Ficus virens* barks have been exhibited the dose-dependent anti-inflammatory potential effect against both heat induced hemolytic method as well as egg albumin protein denaturation method respectively [22].

10. Pharmacognostical studies of *Ficus virens* barks:

The present study has been tested for their isolation, characterization and investigation of the glycosides from the methanolic extract of *Ficus virens* barks. It has been revealed and reported that, the phytochemical investigation of methanolic extract of *Ficus virens* barks has been afforded a 6-α-D-tetraglucoside and it has been demonstrated a plenty of potential effects as a natural chemical source for the development of new curative medicines, which has been used to treat apoplexy, blood diseases, bone fracture, delirium, diabetes, leucorrhea, pain, rheumatism, gastric ulcer, skin ulcer and vertigo [23].

Table 2: The complete summary of biological properties of *Ficus infectoria* (Roxb.)

Sl. No.	Plant parts used	Solvents used	Biological activities	Animals/Micro organisms used	References
01.	Leaves, Stem bark	Methanol	Hepato-protective	Wistar albino rats	Gupta A K *et al*., (2013) [14]
02.	Leaves	Methanol, Acetone, Aqueous	Anti-bacterial	Staphylococcus aureus (bacterial strain)	Jassal P S *et al*., (2019) [15]
03.	Fruits	Methanol, Ethanol	Neuro-protective	Male albino mice	Zahid K *et al*., (2018) [16]
04.	Fruits	Alcohol, Aqueous	Anti-oxidant	Hydrogen peroxide	Mir P A *et al*., (2022) [18]
05.	Leaves	Alcohol, Aqueous	Anti-filarial	Setaria cervi (cattle parasite)	Kumar V H *et al*., (2007) [19]
06.	Stem bark	Pet ether, Chloroform, Ethanol, Aqueous	Anthelmintic	Eisenia fetida (earthworm)	Kataria J *et al*., (2016) [20]
07.	Fruits, Cork	Ethanol	Anti-diabetic	Adult female wistar rats	Mule V S *et al*., (2022) [21]

Conclusion

Overall, the focus of the present review has been described the phytochemical profile and pharmacological activities of medicinal plant *Ficus infectoria* (Roxb.), which has been traditionally used for its effectiveness in the treatment of various diseases and disorders. The various bio-active phytochemical constituents have been identified in this plant, such as flavonoids, phenolic compounds, tannins, terpenoids, saponins, carbohydrates, glycosides, alkaloids, proteins and amino acids. The plant has been demonstrated the diverse pharmacological studies, such as hepato-protective, anti-bacterial, neuro-protective, anti-oxidant, anti-diabetic, anti-inflammatory, anti-filarial and anthelmintic activities. Henceforth, the plant extracts have been shown promising results in various animal models, indicating its potential for use in the treatment of Human ailments. Moreover, various fascinating pharmacological activities of *Ficus infectoria* (Roxb.) have been done, which can be additionally investigated to utilize them as a recuperating strategy. However, further research studies are needed to thoroughly investigate the plants chemical composition, isolate and identify the bio-active phytocompounds as well as the exact mechanism, which are responsible for its pharmacological activities, as well as its potential utilization in therapeutic applications.

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