



**INTERNATIONAL JOURNAL OF
PHARMACEUTICAL SCIENCES**
[ISSN: 0975-4725; CODEN(USA): IJPS00]
Journal Homepage: <https://www.ijpsjournal.com>



Review Article

A Comprehensive Review on Phytochemistry and Pharmacological Potential of *Flueggea Leucopyrus*

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ARTICLE INFO

Published: 3 Dec 2025

Keywords:

Flueggea leucopyrus,
phytochemistry, antioxidant,
anticancer, ethnomedicine.

DOI:

10.5281/zenodo.17804157

ABSTRACT

“Flueggea leucopyrus” Willd, commonly known as bush weed or Indian snowberry, is a widely used ethnomedicinal plant in Sri Lanka, India, and other parts of Asia. Traditionally, it has been employed to manage cancer, asthma, cough, diarrhoea, skin infections, ulcers, urinary disorders, mental illness, and wounds. Phytochemical investigations have revealed diverse bioactive constituents, including alkaloids, flavonoids, phenolics, tannins, saponins, glycosides, steroids, proteins, and carbohydrates, which contribute to its pharmacological activities. Experimental studies demonstrate that *F. leucopyrus* exhibits strong antioxidant, anticancer, anti-inflammatory, antimicrobial, hepatoprotective, gastroprotective, wound-healing, and anxiolytic effects, largely mediated through free radical scavenging and immunomodulatory pathways. Notable findings include radical scavenging potential in DPPH and FRAP assays, cytotoxicity against cancer cell lines, and anti-anxiety effects in rodent models, providing a scientific basis for its traditional applications. Beyond medicinal relevance, its extracts have also shown promise as eco-friendly corrosion inhibitors, indicating potential industrial applications. Overall, *F. leucopyrus* emerges as a versatile shrub with significant therapeutic and nutraceutical potential. This review consolidates ethnomedicinal uses and scientific evidence, while emphasising the need for bioactive compound isolation, mechanistic exploration, clinical trials, and standardised formulations to maximise its medicinal and industrial value.

INTRODUCTION

Medicinal plants have played a pivotal role in the development of traditional and modern therapeutics. Among them, *Flueggea leucopyrus*

(*syn. Flueggea leucopyrus* Willd.), commonly known as “white berry bush,” is a lesser-known but pharmacologically significant plant belonging to the family Phyllanthaceae. It is widely distributed in tropical and subtropical regions, particularly in India and Sri Lanka, where it has

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Relevant conflicts of interest/financial disclosures: The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.



been traditionally used in Ayurveda and folk medicine. Various parts of the plant, including leaves, roots, bark, and fruits, are utilized for the treatment of ailments such as inflammation, fever, diabetes, respiratory disorders, and microbial infections. Recent phytochemical investigations have revealed the presence of diverse bioactive compounds such as alkaloids, flavonoids, tannins, terpenoids, and glycosides, which are believed to contribute to its wide spectrum of pharmacological effects. Experimental studies have demonstrated antioxidant, antimicrobial, anticancer, and anti-inflammatory properties, highlighting its therapeutic potential. However, despite promising preclinical findings, comprehensive evaluation and clinical validation remain limited. The present review aims to summarise and critically analyse available literature on the botanical characteristics, ethnomedicinal uses, phytochemistry, pharmacological activities, toxicity, and future

research prospects of *Flueggea leucopyrus*. By integrating traditional knowledge with modern scientific evidence, this review seeks to provide a holistic understanding of the plant's therapeutic relevance and potential applications in drug discovery. (Bulugahapitiya and Munasinghe (2018) and Karthikeyan and Muthusamy (2023))

1.1 TAXONOMICAL CLASSIFICATION

- **Kingdom:** Plantae
- **Division:** Angiosperms
- **Class:** Eudicots
- **Order:** Malpighiales
- **Family:** Phyllanthaceae
- **Genus:** *Flueggea*
- **Species:** *Flueggea leucopyrus* (Willd.) Willd.

1.2 BOTANICAL DESCRIPTION:

Table no.1: Botanical Description

Category	Description
Taxonomy	Kingdom: plantae, order: malpighiales, family: phyllanthaceae, genus: fluggea, species: F. leucopyrus wild.
Synonyms	Securinea leucopyra, Phyllanthus leucopyrus
Common names	Katupila {Sri Lanka}, bush weed, Indian snowberry, putrajivaka {India}
Habit	Erect thorny shrub or small tree, 2-4 m tall, much-branched, spinescent
Stem\bark	Young stems green and smooth mature bark greyish brown, thin, rough
Leaves	Simple, alternate, distichous: ovate to obovate :1-3cm long entire margin: globous, pale green
Fruit	Globose drupe/berry 5-7 mm, white and translucent when ripe enclosing 3-6 seeds
Seed	Tiny, oblong, brown, 1 per cell
Flowering season	March-June
Distribution	Tropical and subtropical Asia: India, Sri Lanka, Myanmar, SE Asia
Habitat	Dry deciduous forests, scrublands, wastelands, agricultural lands: sandy soils
Distinguish features	Rigid thorny bush with spiny branchlets

1.3 DISTRIBUTION

Flueggea leucopyrus is widely distributed in tropical and subtropical regions of Asia. It is commonly found in India, Sri Lanka, Bangladesh, Myanmar, Thailand, and parts of Southeast Asia.

In India, it grows abundantly in dry, rocky plains, scrub forests, and wastelands, especially in southern and western regions. The plant adapts well to arid and semi-arid conditions and thrives in well-drained soils.



1.4 PROPAGATION AND CULTIVATION

Flueggea leucopyrus is mainly propagated through seeds and occasionally by stem cuttings. Fresh seeds germinate easily under warm conditions. The plant prefers well-drained sandy or loamy soil and thrives in sunny, dry locations. It is drought-tolerant and requires minimal care once established. Regular pruning helps maintain its shape and promotes new growth. The species can be cultivated as a hedge plant or in dryland plantations due to its hardy and adaptable nature.

1.5 TRADITIONAL USES

Sri Lanka: Widely known as Kauppila and traditionally used topically as a paste (Kalka) to treat chronic and non-healing wounds, boils, ulcers and to promote wound healing. It is also used internally in several folk recipes for tumours, liver ailments and other chronic conditions. Several Sri Lankan ethnomedical surveys and experimental studies highlight its frequent local medicinal use. (Bulugahapitiya and Munasinghe, 2018; Wijayabandara and Soysa, 2016)

India (including Western Ghats & dry-zone areas): Used by tribal and rural communities to treat skin infections, wounds, haemorrhoids, gastrointestinal complaints and as an anthelmintic (e.g., leaf juice/paste with tobacco to remove worms from sores). Young branches are also reported as utilitarian (brooms) in some regions. Tropical Plants (Prabhakaran and Sabu, 2014)

Other regions (broader distribution): Reports from ethnobotanical compendia indicate local edible uses (young leaves, fruits) and varied medicinal uses in parts of South and Southeast Asia and Africa; however, specific folk remedies differ by region and community. Plant parts used Leaves (most commonly): topical pastes, decoctions,

juices, eaten as a vegetable in some locales; widely used for wound healing, skin ailments, and internal decoctions. Aerial parts (stems/branches): decoctions and extracts for various internal complaints; young branches used as brooms in local communities. Roots: used in decoction form for abdominal pain and some internal disorders in traditional recipes. Fruits: reported edible by some tribal groups and occasionally used in folk remedies. Whole-plant / stem bark: employed in some local formulations less commonly than leaves but present in ethnobotanical records (Verma and Bharadwaj, 2011)

1.6 COMMON PREPARATION METHODS:

Kalka (paste): Fresh leaves are crushed or ground to a paste and applied topically to chronic wounds, boils, ulcers and skin lesions. This is the classical topical form in Sri Lankan practice.

Decoction (kwath): Leaves, roots or aerial parts boiled in water to make a concentrated decoction for drinking—used for liver complaints, abdominal pain, haemorrhoids, and as general internal therapy in some folk prescriptions.

Juice / fresh extract: Leaf juice taken orally (sometimes mixed with honey or milk) for various internal complaints, and combined with other plant juices in multi-herb remedies (e.g., with hemp leaves or turmeric in locally reported recipes).

Powder / dried leaf preparations: Leaves dried and powdered for use as herbal powders or teas; currently marketed in some places as Kauppila powder.

2. PHYTOCHEMISTRY

Phytochemical constituents of *Flueggea leucopyrus*:

Table no.2 Phytochemical constituents of *Flueggea leucopyrus*



Plant part	Phytoconstituents identified	Method of identification	References
Leaves	Alkaloids, glycosides, phenolics, flavones, flavonoids, carbohydrates, terpenoids, saponins	GC-MS and FT-IR analysis	Sarath Lal, Thirumal and Ajit Babu, 2024
Bark	Alkaloids, glycosides, phenolics, saponins, flavonoids	GC-MS and FT-IR analysis	(Bulugahapitiya and Munasinghe,2022)
root	Alkaloids, flavonoids, carbohydrates, proteins, phenolic content	GC-MS and FT-IR analysis	Rajendran and Lakshmi, 2022
Stem	Saponins, tannin, steroids, catechin, alkaloids, flavonoids	Flame photometer	Suresh and Saravana Ganthi, 2021

2.1 Phytochemical parameters

Table no.3 Phytochemical parameters

Sr.no	Parameters	Weight %	References
1	Total ash	3.08 %	Senevirathna and Wijesekara, 2016
2	Water soluble ash	0.84%	Senevirathna and Wijesekara, 2016
3	Acid soluble ash	2.65%	Anto Arockia Raj, Vinnaras and Venkataraman, 2016
4	Sulphated ash	5.53%	Anto Arockia Raj, Vinnaras and Venkataraman, 2016
5	Petroleum ether	1.18%	Anto Arockia Raj, Vinnaras and Venkataraman, 2016
6	Chloroform	0.75%	Anto Arockia Raj, Vinnaras and Venkataraman, 2016
7	methanol	13.07%	Anto Arockia Raj, Vinnaras and Venkataraman, 2016
8	Moisture content	31.62%	Anto Arockia Raj, Vinnaras and Venkataraman, 2016

2.3 Quantitative estimation of phytochemical constituents in fluggea leucopyrus

Table no.4: Quantitative estimation of phytochemical constituents in fluggea leucopyrus

Sr.no	Phytoconstituents	Leaves	Stem	Roots	References
1	Total alkaloids mg/kg	2.52	2.48	2.52	Karthikeyan and Muthusamy, 2023
2	Total flavonoids mg/kg	2.89	2.90	2.92	Karthikeyan and Muthusamy, 2023
3	Tannin mg/kg	0.55	0.52	0.56	Suresh and Saravana Ganthi, 2021
4	Lignin mg/kg	0.31	0.29	0.26	Suresh and Saravana Ganthi, 2021
5	glycosides mg/kg	0.10	0.03	0.03	Suresh and Saravana Ganthi, 2021
6	Serpentines mg/kg	0.05	0.02	0.021	Suresh and Saravana Ganthi, 2021
7	Phenols mg/kg	2.11	3.46	1.94	Suresh and Saravana Ganthi, 2021

3. PHARMACOLOGICAL POTENTIAL

1. Antimicrobial studies:

- a. **Antibacterial activity:** the ethanolic extract of *Fluggela leucopyrus* leaves has a significant antibacterial effect on both gram-positive (*S. aureus* and *B. subtilis*) as well as gram-negative (*E. coli* *P. aeruginosa*, and *P.*

vulgaris) bacteria. At various concentrations (50,100,200 micro gram/ml). It was found that the inhibitory power of the plant against the bacterial species was good at higher concentrations on comparing the standard chloramphenicol (Helina, Kumar and Prasad, 2015)



2. **Antifungal activity:** at various concentrations the ethanolic leaves extract of the plant shows the antifungal effect against fungal species such as *A. niger*, *C. lunata* and *A. solani* by disc diffusion method on comparing with standard ketoconazole. (Helina, Kumar and Prasad, 2015)
3. **Antianxiety activity:** an ethanolic extract of plant leaves was administered orally at different concentrations anxiolytic activity was studied by using the light and dark model and mirror chamber test. The results demonstrate that both doses significantly reduce anxiety-like behaviour. (Silva and Fernando, 2020)
4. **Antioxidant activity:** *Flueggea leucopyrus* is a medicinal plant known for its antioxidant properties, largely attributed to the presence of bioactive compounds such as phenolics, flavonoids, and tannins. Extracts from its leaves, particularly aqueous and methanolic forms, have demonstrated the ability to neutralize free radicals in several in vitro assays, including DPPH and FRAP. The plant shows a moderate level of total phenolic and flavonoid content, which supports its antioxidant capacity. Additionally, some in vivo studies suggest that its antioxidant activity may contribute to observed anti-inflammatory effects. Despite promising results, further research is required to identify specific active constituents and evaluate their potential in clinical applications. (Soysa, Suresh, and Senevirathne (2014)
5. **Antidiabetic activity:** *Flueggea leucopyrus* is a traditional medicinal plant that exhibits both antioxidant and antidiabetic properties. Its leaves and roots contain bioactive compounds such as flavonoids, phenolic acids, alkaloids, and tannins, which contribute to its pharmacological activities. Antioxidant assays like DPPH and FRAP have shown that the plant extracts can effectively scavenge free radicals, suggesting a role in reducing oxidative stress. In terms of antidiabetic activity, experimental studies in animal models have demonstrated that extracts of *F. leucopyrus* can significantly reduce blood glucose levels, possibly by enhancing insulin sensitivity or inhibiting carbohydrate-digesting enzymes such as α -amylase and α -glucosidase. These dual activities make the plant a promising candidate for managing oxidative stress-related disorders, including diabetes. However, further studies are necessary to isolate the active compounds, understand their mechanisms, and validate their efficacy through clinical trials (Gunasekara and Perera, 2021)
6. **Anthelmintic activity:** *Flueggea leucopyrus* has shown promising anthelmintic activity in traditional and experimental studies. Extracts from the plant, particularly the leaves, have been reported to induce paralysis and death in helminths such as *Pheretima posthuma* and *Ascaris lumbricoides* in a dose-dependent manner. This activity is believed to be due to the presence of phytochemicals such as tannins, alkaloids, and flavonoids, which may interfere with the parasites' energy metabolism or neuromuscular function. Comparatively, the plant's effect has shown results similar to standard anthelmintic drugs in some in vitro studies, supporting its traditional use in the treatment of worm infestations. Further research is needed to isolate the active compounds and explore their mechanisms of action in vivo. (Perera and Jayasuriya, 2019)

7. **Wound healing:** *Flueggea leucopyrus* has been traditionally used for wound healing, and recent studies support its effectiveness in promoting tissue repair. The plant contains bioactive compounds such as flavonoids, tannins, and saponins, which are known to facilitate wound contraction, epithelialization, and collagen synthesis. Experimental models have demonstrated that topical application of *F. leucopyrus* leaf extract can accelerate wound closure, reduce inflammation, and enhance the regeneration of skin tissues. Its antioxidant and antimicrobial properties also contribute to a favourable healing environment by preventing oxidative damage and secondary infections. These findings suggest that *F. leucopyrus* holds potential as a natural remedy for wound management, though more clinical studies are needed to confirm its efficacy and safety in humans (Perera and Jayasuriya (2019)
9. **Anti-inflammatory:** *Flueggea leucopyrus* has demonstrated significant anti-inflammatory activity in both traditional medicine and experimental studies. Extracts from the plant, especially the leaves and roots, have been shown to reduce inflammation in animal models, such as carrageenan-induced paw edema. The anti-inflammatory effect is likely due to the presence of bioactive compounds like flavonoids, tannins, and alkaloids, which can inhibit the production of pro-inflammatory mediators such as prostaglandins and cytokines. Additionally, its antioxidant properties may contribute to this effect by reducing oxidative stress, which often accompanies inflammation. These findings support the plant's traditional use for treating inflammatory conditions, although further research is needed to isolate the active constituents and confirm their mechanisms of action in clinical studies (Subramanian and Krishnamurthy (2024)
8. **Anticonvulsant activity:** *Flueggea leucopyrus* has been investigated for its potential anticonvulsant activity, supporting its traditional use in neurological disorders. Preliminary pharmacological studies suggest that extracts from the plant may help reduce the frequency and severity of seizures in experimental animal models. The anticonvulsant effect is thought to be mediated through the modulation of neurotransmitters, particularly gamma-aminobutyric acid (GABA), which plays a key role in inhibiting neuronal excitability. Phytochemicals such as alkaloids and flavonoids present in the plant may contribute to this activity by stabilizing neuronal membranes and suppressing abnormal electrical discharges in the brain. While initial findings are encouraging, comprehensive studies are needed to elucidate the exact mechanisms and to assess the plant's safety and efficacy in clinical settings. (Kumar and Singh (2017)
10. **Antianxiety activity:** *Flueggea leucopyrus* has shown potential antianxiety activity in preliminary studies, aligning with its traditional use in managing mental health conditions. Experimental animal models, such as the elevated plus maze and open field tests, have indicated that extracts of the plant may reduce anxiety-like behaviour. This effect is believed to be mediated by the modulation of the central nervous system, possibly through interaction with GABAergic pathways, similar to standard anxiolytic drugs. The presence of phytochemicals like flavonoids and alkaloids, known for their neuroactive properties, may play a crucial role in this

activity. While initial results are promising, further pharmacological and clinical investigations are required to validate the antianxiety potential of *F. leucopyrus* and understand its underlying mechanisms (Silva and Fernando (2020)

11. Anticancer activity: *Flueggea leucopyrus* is a medicinal plant known for its traditional use in treating cancer and related conditions. Research has shown that its extracts contain bioactive compounds like flavonoids and alkaloids, which may contribute to anticancer effects. Laboratory studies have demonstrated that these extracts can inhibit the growth of certain cancer cells by inducing apoptosis and reducing oxidative stress. Its use in traditional medicine, especially in Ayurveda, supports its potential as a natural source for anticancer agents, though further clinical studies are needed to confirm its effectiveness (Jayawardena and Soysa (2014)

12. Memory and cognitive improvement: *Securinega leucopyrus* has shown promise in enhancing memory and learning in experimental Alzheimer's disease models. Research using rats with induced cognitive deficits indicates that treatment with the plant extract improves outcomes in behavioural tests designed to evaluate memory and learning. These beneficial effects may result from neuroprotective actions, including antioxidant properties and modulation of neurotransmitter systems that regulate cognition. Bioactive compounds such as flavonoids and alkaloids, known for their effects on the nervous system, are likely contributors to these cognitive benefits. Despite these encouraging results, additional pharmacological and clinical research is necessary to validate the memory-enhancing

potential of *S. leucopyrus* and to clarify its underlying mechanisms (Gopi Chand et al., 2019).

13. Diuretic activity: *Flueggea leucopyrus* has been shown to increase urine output in experimental studies using rat models. Administration of the aqueous extract resulted in a significant rise in urine volume, suggesting an aquaretic or diuretic effect. These effects may be attributed to the phytochemical constituents present in the plant, which could influence renal function and electrolyte balance. Importantly, the study indicated no apparent toxicity at the tested doses, supporting the potential safe use of the extract for diuretic purposes. These findings provide a scientific basis for the traditional use of *F. leucopyrus* in promoting urinary excretion and managing related conditions (Ellepola et al., 2015).

14. Aphrodisiac activity: *Flueggea leucopyrus* leaves have demonstrated potential aphrodisiac effects in preclinical studies. Aqueous leaf extracts were evaluated in animal models, showing significant enhancement in mating behaviour, sexual performance, and reproductive organ parameters. Treated animals exhibited increased mount and intromission frequencies, prolonged ejaculatory latency, and improved sperm count and reproductive organ weight. Phytochemical analysis revealed the presence of alkaloids, flavonoids, terpenoids, glycosides, saponins, tannins, and other bioactive compounds, which may contribute to these effects. These findings support the traditional use of *F. leucopyrus* for enhancing sexual function and suggest further pharmacological studies are warranted (Vasantrao and Biyani, 2020).

15. Antimicrobial and preservative activity:

Extracts of *Flueggea leucopyrus*, along with other medicinal plants, have demonstrated antimicrobial activity against common milk pathogens. The study showed that these plant extracts can inhibit microbial growth, indicating potential as natural preservatives for dairy products. Additionally, biocompatibility assessments suggested that the extracts are safe for use, supporting their application in food preservation. These findings highlight the potential of *F. leucopyrus* as a source of antimicrobial agents for both food safety and pharmaceutical applications (Jayaweera et al., 2024).

16. Management of post-excisional wound myiasis:

Ayurveda-based interventions have been successfully applied in managing myiasis in post-excisional wounds of malignant lesions. In a reported case, traditional Ayurvedic treatments were used to control maggot infestation and promote wound healing, demonstrating the potential of integrative approaches in wound care. This case highlights the relevance of Ayurvedic therapies in managing complications associated with post-surgical wounds and suggests further investigation into their efficacy and safety (Kapadiya et al., n.d.).

CONCLUSION

Flueggea leucopyrus is a medicinal plant rich in diverse phytochemicals, including flavonoids, phenolics, tannins, alkaloids, and saponins, which contribute to its wide range of pharmacological activities. Scientific investigations have demonstrated its promising antioxidant, anti-inflammatory, antidiabetic, anthelmintic, anticonvulsant, antianxiety, and wound healing properties. These biological activities support its traditional use in various therapeutic applications.

However, despite encouraging preliminary results, most studies remain limited to in vitro or animal models. Therefore, further research is essential to isolate and characterize the active compounds, elucidate their mechanisms of action, and conduct clinical trials to establish safety and efficacy in humans. Overall, *Flueggea leucopyrus* holds significant potential as a source of natural bioactive compounds for the development of novel therapeutic agents.

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HOW TO CITE: Prapti Jadhav, Wadulkar R.D., Satpute K.L., Kamble N.R., Mali Y.A, A Comprehensive Review on Phytochemistry and Pharmacological Potential of Flueggea Leucopyrus, Int. J. of Pharm. Sci., 2025, Vol 3, Issue 12, 598-607. <https://doi.org/10.5281/zenodo.17804157>

