

REVIEW ARTICLE

Pharmacological and Phytochemical Insights into *Strobilanthes alternata*: A Multifunctional Medicinal Plant

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ABSTRACT

Strobilanthes alternata (syn. *Hemigraphis colorata*), a member of the Acanthaceae family, is a low-growing, ornamental and medicinal plant valued for its vibrant foliage and wide range of therapeutic properties. Traditionally used in Indian and Southeast Asian folk medicine, it is known for its wound-healing, antidiabetic, anti-inflammatory, antioxidant, and antimicrobial activities. Phytochemical studies have identified bioactive compounds such as flavonoids, alkaloids, saponins, phenolic acids, and terpenoids, contributing to its pharmacological potential. Methanolic and hydroalcoholic extracts have demonstrated efficacy in accelerating wound healing, including in diabetic rat models, and show antibacterial activity against *E. coli*, *K. pneumoniae*, and other pathogens. Antioxidant properties were confirmed using ferrous ion chelation and nitric oxide scavenging assays. Anti-inflammatory activity was observed through BSA protein denaturation inhibition. Additionally, the plant has shown potential for cadmium phytostabilization, especially with 6-Benzylaminopurine (6-BAP) treatment, which enhances physiological resilience and elemental regulation. *Strobilanthes ciliatus*, another species from the genus, exhibited notable antimicrobial activity against various bacteria and fungi. Furthermore, *S. alternata* serves as an effective indoor air purifier and ground cover in low-maintenance landscapes. Collectively, these findings highlight the genus *Strobilanthes* as a valuable source of bioactive compounds with promising pharmacological, ecological, and ornamental applications.

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KEYWORDS

• Bioactivities • Ethnomedicine • Pharmacology • Phytochemical Secondary Metabolites • *Strobilanthes Alternata*

INTRODUCTION

Phytochemicals, also known as secondary metabolites, are bioactive compounds predominantly derived from plant sources. In plants, two categories of metabolites are produced: primary and secondary metabolites. Primary metabolites are essential for fundamental physiological processes such as growth and development. In contrast, secondary metabolites are not directly involved in these vital functions but serve various ecological and defensive roles.

Medicinal plants are particularly rich in these secondary metabolites, which include tannins, alkaloids, carbohydrates, terpenoids, steroids, and flavonoids. These organic compounds can exert specific physiological effects on the human body. Synthesized through primary or more often secondary metabolic pathways, these substances are chemically diverse and taxonomically widespread, often with unclear functions in the plant itself [Thejashwini *et al.*, 2024].

Phytochemicals are recognized for their broad pharmacological and biological properties. Notably, many possess antioxidant activity such as hydrolysable tannins, phenolic acids, and flavonoids which contributes to health maintenance and protection against diseases like coronary heart disease and cancer. Additionally, they exhibit anti-carcinogenic and anti-mutagenic effects [Bharathi *et al.*, 2016; Majid *et al.*, 2017; Kaveri *et al.*, 2024].

Genus *Strobilanthes*

The genus *Strobilanthes*, belonging to the family Acanthaceae, is one of its largest and most ancient groups [Wood, 1995]. The name *Strobilanthes* is derived from the Latin words *strobilos* meaning “cone” and *anthos* meaning “flower or shoot” [Suseem and Preethi, 2014]. Globally, the genus comprises approximately 350 to 454 accepted species, with about

167 species found in India, of which nearly 66 are endemic.

In tropical Asia, *Strobilanthes* is represented

by around 300 species, with the Indian subcontinent alone harboring about 150 species 59 of these occurring in peninsular India. Despite its diversity, the genus remains underexplored in terms of economic and medicinal potential. Notable species include *S. ciliatus*, *S. kunthiana*, *S. cusia*, *S. callosus*, *S. crispus*, *S. discolour*, *S. auriculatus*,

S. hamiltoniana, and *S. alternata* [Upadhyay *et al.*, 2023].

Among these, *Strobilanthes ciliatus* stands out as an endemic species with significant medicinal value, traditionally used in Ayurveda as a source of the drug ‘Sahacharya’. The Western Ghats of India, a recognized biodiversity hotspot, serve as a rich reservoir for such medicinal plants.

The phytochemical profiling of *Strobilanthes* species using standardized solvent extraction methods enables the identification of a wide range of chemical constituents. Such comparative analyses between different plant organs and related species are essential for pharmacognostic evaluation. Direct traditional use of crude plant parts is discouraged, as they may contain various non-bioactive compounds alongside active constituents. Thus, understanding the purity, stability, and composition of bioactive compounds is crucial in medicinal plant research.

The present study, therefore, aims to investigate the phytochemical composition of ten *Strobilanthes* species collected from the northern Western Ghats of India [Fernandes *et al.*, 2016].

Strobilanthes alternata (*Hemigraphis colorata*)

Strobilanthes alternata, synonymously known as *Hemigraphis colorata* (Acanthaceae), is a low-growing, perennial herb native to tropical regions, including India. It grows to a height of 15–30 cm and exhibits a creeping habit with rooting stems when cultivated on soil. In hanging baskets, its trailing stems drape gracefully. The genus name *Hemigraphis*

translates to “half writing,” referring to the brush-like fibers of its outer stamens.

The plant is distinguished by its striking foliage leaves exhibit a metallic purple sheen on the upper surface and a deep purple coloration on the underside. Leaves are opposite, ranging from ovate to cordate in shape, with serrate to crenate margins, measuring approximately 2–8 cm in length and 4–6 cm in width, and prominently veined. Flowering is irregular year-round in tropical climates. The small, bell-shaped flowers (1–1.5 cm in diameter) are five-lobed, white with purplish markings inside, and borne in terminal spikes measuring 2–10 cm. Fruits are small, slender, oval capsules that are light green, containing flat, white seeds.

Traditionally, *S. alternata* has been employed in various indigenous systems of medicine. Historically used for ornamental purposes in aquariums and goldfish bowls, the plant has since gained attention for its medicinal value. Its leaf juice is commonly applied to open wounds to stop bleeding and promote healing. Folk medicine recognizes its effectiveness in treating cuts, ulcers, skin irritations, bleeding, and vitiated *pitta* conditions. Internally, the leaves are used to treat anaemia, menorrhagia, kidney and gallstones, and even as a natural contraceptive.

In Vanuatu, for example, a decoction made from the crushed leaf buds is consumed at dawn for four consecutive days as a contraceptive and to induce sterility. In Java, the leaves are traditionally used to manage bloody diarrhea and hemorrhoids [Sushma et al., 2020].

Phytochemical analyses of *S. alternata* reveal the presence of xanthoproteins, tannins, proteins, steroids, chlorogenate, flavonoids, alkaloids, triterpenes, carbohydrates, amino acids, and phenols. These constituents are attributed to the plant's healing potential and pharmacological activities. Leaf extracts are particularly valued in promoting wound healing, controlling bleeding, and treating various internal disorders. Owing to its wide range of bioactive compounds, *S. alternata* holds significant potential in herbal medicine and pharmacognostic studies [Sherlin et al., 2025]

Common Names in Different Regions

Strobilanthes alternata, commonly known as *Hemigraphis colorata*, is recognized by various names across different regions due to its

notable wound-healing properties. In Kerala, it is locally referred to as “Murikootti” and “Murian Pacha”, both names highlighting its traditional medicinal value. The term *Hemigraphis* itself translates to “partial writing”, referring to the brush-like structures on the outer stamen filaments.

The plant is also widely known by several other names such as Waffle Plant, Java Ivy, Red Flame Ivy, Metal Leaf, Aluminum Plant, Purple Wafer Plant, Cemetery Plant and Graveyard Plant, reflecting its ornamental appeal and widespread use. In Ayurvedic medicine, it is called “Vranaropani”, which means “healer of wounds”, underscoring its traditional role in treating cuts and injuries [Sherlin et al., 2025].

CLASSIFICATION:

- Kingdom: Plantae
- Phylum: Streptophyta
- Class: Equisetopsida
- Subclass: Magnoliidae
- Order: Lamiales
- Family: Acanthaceae
- Genus: *Strobilanthes*
- Species: *Strobilanthes alternata* [Wood 2014]

1. Vernacular name

Kannada: Tincture ghida

English: Cemetery plant, Aluminium plant, red flame ivy, Metal leaf, Tincture plant.

Sanskrit: Vranaropani

Malayalam/Tamil: Murikooti [Thejashwini et al., 2024].

Strobilanthes alternata, formerly known as *Hemigraphis colorata*, belongs to the family Acanthaceae. According to the International Plant Name Index (IPNI, 2021), the accepted nomenclature has been updated to *Strobilanthes alternata*. This change was published online in collaboration with the Royal Botanic Gardens, Kew; Harvard University Herbaria and Libraries; and the Australian National Botanic Gardens [Karthika Devarajan, 2022].

Taxonomically, *S. alternata* has undergone several reclassifications due to its morphological similarities with species from both *Strobilanthes* and *Hemigraphis* genera. Despite some confusion, recent molecular

and morphological studies support its current classification under the genus *Strobilanthes*, known for its taxonomic complexity and ornamental diversity. While many species within this genus exhibit periodic mass flowering over extended cycles, *S. alternata* deviates from this pattern by flowering more consistently under favorable environmental conditions.

Traditionally, *S. alternata* has been widely used in indigenous medicinal systems across India, Malaysia, and the Philippines. The leaves are commonly used in the form of decoctions or topical applications to treat wounds, skin infections, inflammation, and digestive disorders. Phytochemical investigations have revealed the presence of various bioactive compounds including flavonoids, alkaloids, saponins, phenolic acids, and tannins. These constituents are associated with antimicrobial, anti-inflammatory, antioxidant, and hepatoprotective properties, supported primarily by in vitro and animal studies. However, clinical evidence on its therapeutic efficacy remains limited.

Beyond its medicinal applications, *S. alternata* also holds ecological significance. Its low-growing, spreading habit, and adaptability to humid, partially shaded environments make it ideal for use as ground cover in erosion control and low-maintenance landscaping. Additionally, the plant contributes to urban biodiversity by creating microhabitats and serving as a food source for various insects and small fauna, enhancing the ecological value of green spaces [Shalima *et al.*, 2025]

CULTIVATION

Strobilanthes alternata (syn. *Hemigraphis colorata*), commonly known as the Purple Waffle Plant, belongs to the family Acanthaceae.

It is a prostrate, spreading plant with rooting stems and is prized for its ornamental foliage. The leaves are slender, angular, and feature serrated, scalloped, or lobed margins. They display a striking reddish-purple hue on the upper surface, a deeper purple underneath, and a silvery-green sheen throughout.

The plant produces small, white, bell-shaped flowers irregularly throughout the year without a fixed blooming pattern. It typically grows to a height of 15–30 cm and spreads extensively, making it ideal as ground cover or

for hanging baskets. Traditionally, the plant is valued in folk medicine for its notable wound-healing and therapeutic properties.

For optimal cultivation, *S. alternata* 'Exotica' thrives in rich, well-drained soil. While it requires consistently moist conditions, care must be taken to avoid waterlogging, especially in indoor settings. During summer and winter, watering should be adjusted to prevent the roots from remaining overly saturated.

For varieties like *Hemigraphis colorata*

'Narrow Leaf', bright, indirect light is preferred. To prevent leaf burn, the plant should be placed in areas receiving filtered sunlight, such as near a window with sheer curtains or in a well-lit terrarium.

Native to tropical Malaysia and Southeast Asia, this species is also grown in regions such as Manila. Due to its attractive foliage, *S. alternata* is widely used for both interior and exterior decoration, enhancing gardens, landscapes, and indoor spaces alike [Suhaila *et al.*, 2024].

USES OF STROBILANTHES ALTERNATA

1. Phytostabilization of Heavy Metals

Heavy metal contamination, particularly by cadmium (Cd), poses a serious environmental threat. *Strobilanthes alternata* has shown strong potential for Cd phytostabilization. A study evaluated the effect of 25 ppm 6-Benzylaminopurine (6-BAP) foliar spray on *S. alternata* grown in Cd-contaminated soil. 6-BAP significantly improved physiological responses by increasing soluble sugars, proteins, alkaloids, phenols, and flavonoids. It also enhanced Cd sequestration in roots, reducing damage to shoots, as confirmed by SEM-EDX. Ionomics and CHNS analysis indicated improved elemental balance. Thus, 6-BAP is a promising, eco-friendly amendment to boost Cd tolerance and phytostabilization in *S. alternata* [Prakash *et al.*, 2025].

2. Antidiabetic Activity

Diabetes impairs wound healing due to persistent hyperglycemia and related complications. *Hemigraphis alternata* exhibits antioxidant, anti-inflammatory, and antidiabetic properties. This study evaluated its hydroalcoholic leaf extract in treating diabetic wounds in STZ + Nicotinamide-

induced rats. The extract, fractionated via flash chromatography, yielded 12 fractions rich in alkaloids, phenols, flavonoids, and terpenoids. An emulgel formulated with the extract significantly promoted wound healing, suggesting its therapeutic potential for diabetic wound management [Thomas *et al.*, 2025].

3. Wound Healing Activity

The methanolic extract of *Hemigraphis colorata* has shown effective wound healing activity, particularly against *Escherichia coli* and *Klebsiella pneumoniae*, using the well diffusion method at 25–100 µg concentrations. [Subramoniam *et al.*] reported accelerated wound contraction and epithelialization from fresh leaf paste. Prakashbabu *et al.* observed significant healing in excisional wounds using methanolic extracts in paraffin, outperforming boric acid. Traditionally, a paste made from the plant, locally known as murikootti, is applied externally for wounds, ulcers, and inflammation. While not effective internally for wounds, it is used for anemia. Recent studies confirm its antibacterial, anti-inflammatory, and antidiabetic properties. [Thejashwini *et al.*, 2024].

4. Murikootti as an Indoor Air Purifier

Murikootti, known for its deep purplish-red foliage, is widely cultivated as an ornamental indoor plant. However, beyond its aesthetic appeal, it also serves a functional purpose. Studies have shown that murikootti is highly effective in removing harmful volatile compounds commonly found indoors such as those released from paints, cleaning products, and deodorants. Simply growing murikootti indoors can offer a natural means of air purification and protection against indoor toxins [Itoozhi Ayurveda, 2014].

5. Antibacterial Activity

The antibacterial activity of *H. alternata* leaf extracts was assessed using the agar disc diffusion method on Muller Hinton Agar. The test involved five Gram-positive, five Gram-negative bacteria, and five fungi. A 25 µL sample (100 µg) was applied, with streptomycin (25 µg) as a positive control and sterile discs as negative controls [Agneeswari *et al.*, 2019].

6. Anti-inflammatory Activity of *Strobilanthes alternata*

The anti-inflammatory potential of *S. alternata* and *S. crispus* was evaluated using the BSA protein denaturation inhibition assay, with diclofenac sodium as the positive control. Plant extracts were incubated with BSA and subjected to heat-induced denaturation. Absorbance was measured at 660 nm, and IC₅₀ values were calculated to assess activity. This study highlights the traditional use of Acanthaceae herbs and investigates their potential as anti-inflammatory agents [Ming *et al.*, 2014].

7. Antioxidant Activity of *Strobilanthes alternata*

The antioxidant potential of *Strobilanthes alternata* was evaluated using ferrous ion chelation and nitric oxide scavenging assays. In the ferrous ion assay, different concentrations (2–10 mg/mL) of the extract showed increased chelation activity, indicated by decreased absorbance at 562 nm. Nitric oxide scavenging was assessed using sodium nitroprusside and Griess reagents, with absorbance measured at 546 nm. Both assays demonstrated significant antioxidant activity, compared with ascorbic acid and BHT. Phytochemical analysis confirmed the presence of flavonoids, alkaloids, saponins, and phenolic acids, contributing to the extract's antioxidant and therapeutic properties [Agneeswari *et al.*, 2019; Shalima *et al.*, 2025].

8. Antimicrobial Activity of *Strobilanthes* Genus

The antimicrobial potential of petroleum ether and methanolic extracts of *Strobilanthes ciliatus* was tested against Gram-negative bacteria (*E. coli*, *S. paratyphi*, *K. pneumoniae*), Gram-positive bacteria (*B. subtilis*, *Corynebacterium*, *M. luteus*), and fungi (*T. rubrum*, *M. gypseum*, *M. purpureus*). Standardized inoculums were prepared in Sabouraud's broth and spread on agar plates using sterile swabs. Extracts (100 µg) and controls (5 µg ciprofloxacin, 10 µg clotrimazole) were placed in quadrants. Plates were incubated for 24–48 hours, and antimicrobial activity was assessed by measuring the zone of inhibition [Venkatachalapathi *et al.*, 2013; Prakash *et al.*, 2025].

SUMMARY

Strobilanthes alternata (syn. *Hemigraphis*

colorata) is a medicinal and ornamental plant from the Acanthaceae family, traditionally used in India and Southeast Asia. Known for its wound-healing, antioxidant, anti-inflammatory, antimicrobial, and antidiabetic properties, it is also valued for air purification and landscaping. Phytochemical studies reveal the presence of bioactive compounds such as flavonoids, alkaloids, saponins, phenolic acids, and terpenoids. Methanolic extracts exhibit wound healing and antibacterial activity against pathogens like *E. coli* and *K. pneumoniae*. Antioxidant potential was confirmed through ferrous ion chelation and nitric oxide scavenging assays. Anti-inflammatory activity was demonstrated using BSA protein denaturation assays. In diabetic wound models, leaf extracts improved healing significantly. Additionally, *S. alternata* shows promise in phytostabilizing cadmium-contaminated soils, especially when treated with 6-Benzylaminopurine

(6-BAP). Antimicrobial studies on *S. ciliatus* also confirmed its broad-spectrum efficacy. Overall, *Strobilanthes* species hold strong potential for pharmacological and ecological applications.

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