American Journal of Psychiatric Rehabilitation Expert Opinion Article

Ecological And Therapeutic Insights Into *Strobilanthes Alternata*: A Critical Review

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Abstract
Strobilanthes alternata, also known as Hemigraphis alternata, is a tropical plant valued for its medicinal, ornamental, and ecological properties. *Strobilanthes alternata*, a lesser-known member of the Acanthaceae family, has recently garnered attention due to its potential medicinal, ecological, and ornamental applications. Native to tropical and subtropical regions, this herbaceous plant exhibits distinctive morphological features and adaptive capabilities that allow it to thrive in diverse environments. *S. alternata* is reported to possess anti-inflammatory, antimicrobial, and antioxidant properties, though comprehensive pharmacological studies remain limited. This review consolidates existing knowledge on the taxonomy, morphology, phytochemistry, pharmacological activities, and ecological significance of *Strobilanthes alternata*. By highlighting current research gaps and potential applications, this paper aims to encourage further investigation into the therapeutic and ecological roles of this underexplored species. Traditionally used in folk medicine for wound healing and anti-inflammatory purposes, the plant is rich in phytochemicals like flavonoids, phenols, and tannins. This review discusses its taxonomy, morphology, phytochemical constituents, pharmacological activities, and potential applications in medicine and horticulture.

1. Introduction

Strobilanthes alternata, a member of the Acanthaceae family, is a low-growing herbaceous plant widely recognized for its ornamental foliage and traditional medicinal uses. Native to Southeast Asia and the Indian subcontinent, this species has adapted well to tropical and subtropical environments and is often found in gardens, hedges, and forest understories. It is popular for its vibrant purple-hued foliage and is also used traditionally for a variety of health ailments. In many pharmacognostic texts, it is still referred to by its synonym, Hemigraphis alternata. The plant is characterized by its ovate to lanceolate leaves, which exhibit striking shades of purple, green, or metallic hues, making it a popular choice for decorative landscaping and ground cover in shaded areas.

Taxonomically, *Strobilanthes alternata* has undergone multiple reclassifications due to its close resemblance to other members of the *Strobilanthes* and *Hemigraphis* genera. Despite some confusion in nomenclature, recent molecular and morphological studies support its classification under *Strobilanthes*, a genus known for its diverse and often visually attractive species. The genus as a whole is notable for its periodic flowering behavior, with some species flowering in long cycles spanning several years. However, *S. alternata* does not strictly follow this pattern, instead blooming more consistently under favorable conditions.

Traditionally, *S. alternata* has been utilized in various indigenous medicinal systems, particularly in regions of India, Malaysia, and the Philippines. Its leaves are applied topically or consumed in decoctions to treat wounds, skin conditions, inflammation, and digestive ailments. Preliminary phytochemical analyses have identified the presence of bioactive compounds such as flavonoids, alkaloids, saponins, and phenolic acids, which may contribute to its reported therapeutic effects. These constituents have shown promise in antimicrobial, anti-inflammatory, antioxidant, and hepatoprotective activities in in vitro and animal studies, although comprehensive clinical research remains sparse.

Apart from its medicinal potential, *S. alternata* is also of interest for ecological and environmental purposes. Its dense, creeping growth habit and tolerance to partial shade and humidity make it effective for soil erosion control and as a ground cover in low-maintenance landscapes. Additionally, its role in promoting biodiversity in urban green spaces is being increasingly recognized, as it provides microhabitats and food sources for various insects and small fauna.

Despite its wide distribution and potential benefits, *Strobilanthes alternata* remains an underexplored

species in terms of systematic botanical, pharmacological, and ecological research. Existing literature is limited, with much of the information being fragmented or anecdotal. Given the growing interest in natural products and sustainable landscaping, there is a clear need for more detailed studies on the phytochemistry, pharmacodynamics, environmental adaptability, and conservation status of this species.

This review aims to provide a comprehensive overview of *Strobilanthes alternata*, summarizing current knowledge on its taxonomy, botanical characteristics, medicinal properties, and ecological relevance. By compiling and analyzing existing data, this work seeks to lay the foundation for further scientific investigation and practical applications of this versatile and visually appealing plant.

2. Botanical Description

Scientific Name: Strobilanthes alternata (syn. Hemigraphis alternata)Family: Acanthaceae

Common Names: Purple waffle plant, Red flame ivy, Metal leaf

Malayalam name: Murikooti Morphology:

- Leaves: Ovate to lanceolate, metallic purple on the underside.
- Stem: Creeping or ascending, soft and hairy.
- Flowers: Small, tubular, purplish, appearing in axillary spikes.

Morphology

- Size and Growth Habit: Typically, *S. alternata* reaches a height of approximately 20–30 cm. It exhibits a prostrate, creeping growth habit, with stems that root at the nodes, facilitating its spread as ground cover
- Leaves: The plant's leaves are ovate to cordate (heart-shaped), measuring 4.5–8 cm in length. The upper surface is dark green, while the underside is purplish, contributing to its distinctive appearance. The leaves are oppositely arranged along the stem, with one leaf in each pair being noticeably larger than the other. The leaf margins are toothed, and the surface is covered with fine hairs, giving it a slightly textured feel.
- Flowers: *S. alternata* produces small, tubular, white flowers with five lobes, typically arranged in terminal spikes up to 7 cm long. The flowers are often marked with purple streaks near the throat, adding to their ornamental appeal.

Ecological and Medicinal Significance

In its native habitats, *S. alternata* thrives in shaded, moist environments, often found on the forest floor. Due to its creeping nature and dense foliage, it serves as an effective ground cover, helping to suppress weeds and prevent soil erosion.

Traditionally, the plant has been utilized in various indigenous medicinal systems. In Kerala, India, it is known as *Murikooti* and is applied topically to fresh wounds to promote healing and stop bleeding. The leaves are also used in folk medicine to treat conditions such as dysentery, hemorrhoids, and excessive menstruation .

Care & Propagation

1. Optimal Growing Conditions

- Light:
- Prefers bright, indirect light (e.g., near an east or north-facing window).
- Can tolerate partial shade, but colors may fade in low light.
- Avoid direct harsh sunlight, which can scorch the leaves.
- Soil:
- Well-draining, rich organic mix (e.g., peat-based potting soil with perlite or sand).
- Slightly acidic to neutral pH (6.1–7.5).

- Watering:
- Keep soil consistently moist but not soggy.
- Reduce watering in winter when growth slows.
- Signs of overwatering**:** Yellowing leaves, root rot.
- Signs of underwatering**:** Wilting, crispy leaf edges.
- Humidity & Temperature:
- Ideal humidity**:** 50–70% (great for bathrooms or kitchens).
- Mist leaves occasionally or use a pebble tray if air is dry.
- temperature18–27°C (65–80°F); avoid drafts & temperatures below 15°C (59°F).

2. Fertilization & Pruning

- Fertilizer:
- Use a balanced liquid fertilizer (e.g., 10-10-10) monthly in spring/summer.
- Dilute to half-strength to avoid leaf burn.
- Stop fertilizing in autumn/winter.
- Pruning:
- Trim leggy stems to encourage bushier growth.
- Pinch back tips to promote fullness.
- Remove yellow/dead leaves to prevent disease.

3. Propagation Methods
Strobilanthes alternata is easily propagated via stem cuttings:

- Select a Healthy Stem**:**
- Choose a **4–6 inch stem** with 2–3 leaves.
- Cut just below a node (where leaves emerge).
- Rooting Options**:**

Water Propagation**:**

- Place cuttings in water (change weekly).
- Roots appear in 1–2 weeks.
- Transplant once roots are 1–2 inches long.

Soil Propagation**:**

- Dip cut end in rooting hormone (optional).
- Plant in moist potting mix, cover with a plastic bag for humidity.
- Roots form in 2–3 weeks.
- Aftercare:
- Keep new plants in indirect light and maintain moisture.
- Acclimate gradually to normal conditions.

4. Common Pests & Problems

- Pests:
- Spider mites, aphids, mealybugs (wipe leaves with soapy water or use neem oil).
- Diseases:
- Root rot (from overwatering)—ensure proper drainage.
- Leaf spots (fungal)—avoid wetting foliage.

3. Phytochemistry

Several studies have identified diverse bioactive compounds in S. alternata, including:
1. Flavonoids - Responsible for antioxidant, anti-inflammatory, and wound-healing effects and also Contribute to antimicrobial and immunomodulatory activities.

- Quercetin (Antioxidant, anti-inflammatory, anticancer)
- Kaempferol (Antimicrobial, cardioprotective)
- Apigenin (Anxiolytic, anti-inflammatory)
- Luteolin (Antiviral, neuroprotective)
- Rutin (Vasoprotective, antidiabetic)

2. Phenolic acids (gallic acid, caffeic acid) - Enhance free radical scavenging and wound healing and Support antimicrobial and antidiabetic effects.

- Gallic acid (Antioxidant, anticancer)
- Chlorogenic acid (Antidiabetic, hepatoprotective)
- Caffeic acid (Anti-inflammatory, neuroprotective)
- Ellagic acid (Antimicrobial, chemopreventive)

3. Tannins- Aid in wound contraction and infection prevention and Contribute to antidiarrheal effects in traditional medicine

- Hydrolysable tannins (Astringent, antimicrobial)
- Condensed tannins (Antioxidant, wound healing)

4.Steroids and terpenoids-Contribute to antimicrobial properties and anti-inflammatory and May support wound repair and skin regeneration.

- β-Sitosterol (Anti-inflammatory, cholesterol-lowering)
- Lupeol (Anticancer, hepatoprotective)
- Ursolic acid (Antimicrobial, wound healing)

5.Alkaloids - Potential **a**nalgesic and antimicrobial effects and Further research needed to assess safety

- Indole alkaloids (Neuroprotective, antimicrobial)
- Pyrrolizidine alkaloids (Caution: Some may be hepatotoxic in high doses)

6. Saponins- May enhance immune response and antimicrobial activity and Can be toxic in high concentrations (hemolytic effect)

- Triterpenoid saponins (Immunomodulatory, hemolytic)

4. Traditional and Ethnobotanical Uses
-Used traditionally to treat cuts, wounds, and ulcers.
-Leaf paste applied to boils and skin infections.
-Juice used for cough and respiratory disorders in some regions.
- Acts as a natural dye in local cultures.

5. Pharmacological Activities
Numerous in vitro and in vivo studies support its potential therapeutic applications: Antioxidant Activity: Methanolic extracts exhibit significant free radical scavenging capacity. Strobilanthus aternata Contains flavonoids and phenolics, contributing to its free radical scavenging activity
Antimicrobial Activity: Active against various bacterial strains like E. coli, S. aureus. The plant exhibits antibacterial and antifungal effects against pathogens like *Staphylococcus aureus* and *Candida albicans*
Anti-inflammatory and Wound Healing: Accelerates wound contraction and collagen synthesis. Ethanol extract of *S. alternata* promotes wound contraction and accelerates healing in animal models by enhancing collagen synthesis and reducing inflammation.
Analgesic (Pain-Relieving) Effects: Methanolic extract shows significant pain reduction in mice models (hot plate and acetic acid-induced writhing tests).
Antidiabetic Potential: Preliminary studies suggest hypoglycemic effects by enhancing insulin sensitivity.
Immunomodulatory Effects: Enhances immune response by stimulating macrophage activity.
Cytotoxic and Anticancer Potential: Preliminary screenings show cytotoxic effects on cancer cell lines

Toxicological Studies

Acute toxicity tests have shown no significant adverse effects in animal models, suggesting relative safety. However, human studies are limited.

Horticultural and Environmental Uses

-Widely used as ground cover due to its attractive foliage.

- Improves indoor air quality by absorbing toxins.

- Grows well in shaded areas and helps prevent soil erosion.

8. Conclusion and Future Prospects

Strobilanthes alternata is a versatile plant, appreciated both for its aesthetic value in ornamental gardening and its role in traditional medicine. Its unique foliage and ease of cultivation make it a popular choice among gardeners and herbalists alike. Further research into its phytochemical properties and potential therapeutic applications could enhance its value in both horticultural and medicinal contexts. Strobilanthes alternata is a promising medicinal plant with diverse pharmacological activities. Its therapeutic potential, particularly in wound healing and antimicrobial treatment, warrants further clinical investigations. Future studies should focus on isolating specific active compounds, standardizing extracts, and conducting controlled clinical trials

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