JOURNAL OF NATURAL REMEDIES
DOI: 10.18311/jnr/2025/49197

SHORT REVIEW

Dichrostachys cinerea: A Review Bridging Traditional Wisdom and Modern Pharmacology for Multi-Target Therapeutic Potential

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Abstract

Dichrostachys cinerea (L.) Wight and Arn., a plant of the Mimosaceae family, is a medicinal plant with multiple uses that is widely distributed in Africa, Australia, India, and Southeast Asia. It has been extensively used in traditional medicine to cure numerous diseases, including infections, inflammatory disorders, pain, respiratory disorders, and reproductive health disorders. Phytochemical analysis confirmed the existence of several biologically active compounds such as flavonoids, polyphenols, alkaloids, saponins, terpenoids, and tannins playing an extensive role in its therapeutic uses. Its traditional use is also supported by laboratory scientific evidence of antimicrobial, anti-inflammatory, antioxidant, bronchodilatory, diuretic, analgesic, and anti-plasmodial activities. Its protein farnesyltransferase inhibitory effect and possible anticancer activity of the new generation suggest a prospect for its anticancer activity, and uterotonic activity may support the induction of labor. Although it is widely applied, more scientific work on the enhancement of the extraction process, pharmacokinetics, and compounds with bioactive properties is necessary for drug discovery.

Major Findings: This review documents the significance of *D. cinerea* in uniting ancient medicine with modern pharmacological discovery and its prospects as a multi-target drug agent.

Keywords: Bioactive Compounds, *Dichrostachys cinerea*, Pharmacological Activities, Phytochemicals, Traditional medicine

1. Introduction

Medicinal plants have been an important component of traditional healing systems globally for millennia[1]. Plant-based medicines are deeply entrenched in most cultures and remain popular due to their accessibility, low cost, and perceived therapeutic benefits. For more than 3,000 years, plant extracts such as pigments have served as insecticides and antimicrobial substances[2]. *D. Cinerea* (L.) Wight and Arn. (DC), which belongs to the Mimosaceae family, is a ground-dwelling herbaceous plant commonly found in Africa, Australia, India, and parts of Southeast Asia. It is also referred to as *Cailliea dichrostachys* and *Dichrostachys glomerata*[3]. Although valued for its medicinal applications, *D. cinerea* is considered invasive in some regions, particularly in the Caribbean, where it thrives in disturbed environments and nutrient-poor soils. Broad use of *D. Cinerea* in African and Asian traditional medicine can be attributed to its great diversity of pharmacological activities. Different parts of the plant, including roots, bark, leaves, and fruit, have been used in the treatment of various diseases. The roots are diuretic, antivenom, and febrifuge and are employed in the treatment of leprosy, diseases of the abdomen[4]. The leaves are used in traditional medicine to alleviate pain, rheumatism, skin diseases, and for miscarriage prevention[5]. The fruit is used for the management of otitis, umbilical hernia, and childhood malaria[4]. Parts of the plant are also used to treat snakebite, stomachache, and as an analgesic in general[5].

There is evidence that *D. cinerea* can be an important natural drug for infectious diseases, inflammation, and analgesia. This work reviews the general applications,

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Article Received on: 29.03.2025 Revised on: 12.06.2025 Accepted on: 02.07.2025

Phytochemistry, and pharmacological activity of *D. cinerea* and how it can be used to develop new drugs.

2. Botanical Description

Dichrostachys cinerea is a very variable shrub or small tree that can grow to 8 ft tall and has spiny branches. Its leaves are bipinnate, and each pinna has glands (Figure 1). The 2.5-cm-long, pendulous flowers possess a purple or pink sterile upper section and a yellow hermaphrodite lower section. Its coiled pods of indehiscent fleshy fruit are decorative. The species is drought-resistant; growing well in clay and disturbed habitats.it is widely spread in Africa, Australia, India, and Southeast Asia[3]. Being called "Vada" in the state of Karnataka, South India[5,6].

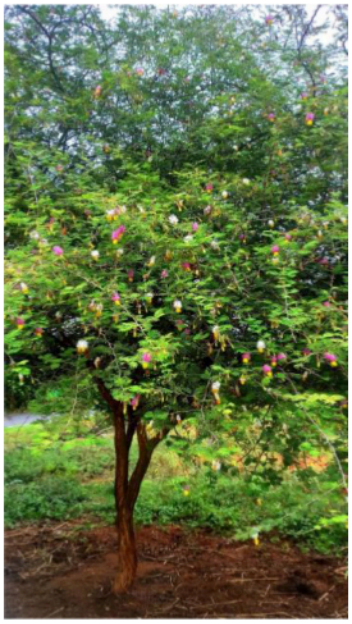

Figure 1. *Dichrostachys cinerea* tree.

3. Phytochemical Screening

Phytochemical screening of *D. cinerea* revealed the presence of a diverse range of compounds across different morphological parts (Table 1).

4. Pharmacological Activity

Dichrostachys cinerea shows multiple pharmacological effects linked to its diverse phytoconstituents as summarized in Table 2.

4.1 Antimicrobial Action

Dichrostachys cinerea has the potential to be a broad-spectrum antibacterial agent against a wide range of Gram-positive and Gram-negative bacteria, including *Staphylococcus epidermidis*, *Proteus mirabilis*, *Staphylococcus typhimurium*, and *Staphylococcus flexneri* (MICs 2.0 µg/mL for *Staphylococcus aureus* and 3.3 µg/mL for *S. flexneri*, for example)[10]. Terpenoids, flavonoids, steroids, and tannins are some of the active metabolites that are responsible for this activity. Polar (methanol, chloroform, and aqueous) extracts are more bioactive than non-polar ones[16-18]. Inhibition of diarrhoeagenic *Shigella* spp. by DCM extracts The DCM extracts show conspicuous inhibition against diarrhoeagenic Shigella spp. (MIC: 0.04 mg/mL), and tannins are effective at 4.0–5.5 mg/mL[19]. The clovamide, another product to represent most of the formulation, exhibits substantial inhibition of H5N1 influenza virus by 74% with high antiviral potential[20].

4.2 Anti-inflammatory and Analgesic Activities

D. cinerea has strong anti-inflammatory and analgesic effects, and its activity is known to be as a result of

Table 1. Phytochemicals identified in different parts of *D. cinerea*

Plant part	Phytochemicals identified	References
Leaves	Carbohydrates, proteins, glycosides, saponins, tannins, amino acids, terpenoids, β-amyrin, apigenin and quercetin derivatives, phenolic compounds, flavonoids, sterols, triterpenes, coumarins, polyphenols, phlobatannins, steroids	7-13
Stem bark	Triterpenes (betulinic acid), sterols, polyphenols, tannins, flavonoids, fatty acids, chromen-4-one derivatives, meroterpene derivatives (*dichrostachines* A–R)	4, 12-14
Roots	Alkaloids, flavonoids, essential oils, phenols, terpenes, tannins, unsaturated sterols, saponins, pyrrolidine derivatives, meroterpene derivatives	4, 5, 15, 16
Fruit	Polyphenols, tannins, proanthocyanidins, flavonols, flavan-3-ol glycosides	4, 13, 16, 17

the presence of polyphenols, flavonoids, saponins, and triterpenoids[20]. In Freund's adjuvant-induced arthritic rats, the extracts of fruits for the treatment group were found to significantly decrease the levels of IL-1β, IL-6 and serum cortisol, where the suppression of paw edema rates was similar to diclofenac[21]. In addition, repeated grinding and sieving operations led to an increase in the availability of these polyphenols, thus increasing antioxidant capacity[22]. Leaves, bark, and root methanolic extracts, particularly saponin-enriched fractions, showed significant anti-inflammatory activity in carrageenan-induced edema models[23]. Protective effect was shown by bark extracts also against histamine-induced anaphylaxis in guinea pigs, indicating that these extracts were anti-inflammatory. Moreover, extracts from the plant exerted marked antinociceptive effects in thermal and mechanical nociception models[24].

4.3 Antioxidant Activity

Low polyphenolic and high flavonoid values showed that the antioxidant potential of *D. cinerea* may be attributed to high polyphenol and flavonoid. The ethanolic fruit extracts show a higher DPPH scavenging and TPC compared to their aqueous extracts[17]. Methanolic leaf and root bark extracts have an inhibitory effect on oxidative enzymes; work with stem bark shows that it activates ROS-mediated cytotoxicity in cancer cells, with betulinic acid as active constituent. Furthermore, methanolic extracts from whole plants have also been found to inhibit AGEs, indicative of more global antioxidant importance[20-22].

4.4 Bronchodilatory Action

Hydro-alcoholic extract of *D. cinerea* root bark causes tracheal relaxation in guinea pig and mouse models when tested against KCl, histamine, and ACh-induced contractions. The mechanism includes the modulation of the β-adrenergic and histaminergic receptors, activation of the K^+ channels (Kv, BKCa), and blockade of the calcium channels. This β2-adrenoceptor-independent effect is similar to that of salbutamol and supports its traditional use for asthma[3,16].

4.5 Diuretic and Anti-urolithiatic Activities

Ayurvedic medicines from plants, including those prepared from roots such as *Veerataru Kwatha*, exhibited dose-dependent diuretic effect in rats, accompanied by enhanced urine volume and sodium output[25]. Probable mechanisms are increased renal perfusion or inhibition of ADH. Furthermore, root extracts lower the levels of urinary oxalate, calcium, and phosphate in urolithiasis models and validate their anti-urolithiatic potential[26].

4.6 Anti-plasmodial Activity

Stem bark dichloromethane (DCM) extracts of *D. cinerea* show remarkable *in vitro Plasmodium falciparum*

Table 2. Pharmacological activities of *D. cinerea*

Activity	Parts used	Key findings	References
Antimicrobial	Fruits, Leaves	Broad-spectrum antibacterial (MIC: 2.0–3.3 µg/mL); clovamide inhibits H5N1 by 74%	10, 16, 18, 19
Anti-inflammatory and analgesic	Fruits, Leaves, Bark, Roots	Reduces edema, IL-1β, IL-6; analgesic effects in mechanical and thermal pain models	20-24
Antioxidant	Fruits, Leaves, Root Bark	Rich in polyphenols/flavonoids; lowers oxidative stress markers	20-22
Bronchodilatory	Root Bark	Inhibits tracheal contraction via K^+ channels and H1-histamine blockade; similar to salbutamol	3, 16
Diuretic and anti urolithiatic	Roots	Enhances urine output; lowers urinary oxalate, calcium, and phosphate	25, 26
Anti-plasmodial	Stem Bark	Active against *Plasmodium falciparum*; 53.12% parasitemia suppression in vivo	11
PFTase inhibition	Root Bark	*Dichrostachines* inhibit protein farnesyltransferase (IC_{50} = 1.8 µM); potential anticancer effect	14
Uterotonic	Stem Bark	Mimics oxytocin; stimulates uterine contractions in isolated myometrium	27

inhibition and 53.12% reduction in *P. berghei*-infected mice, perhaps through flavonoids, glycosides, tannins, steroids[11].

4.7 Inhibition of Protein Farnesyltransferase

The root bark meroterpenes, dichrostachins, are powerful PFTase inhibitors with IC_{50} values down to 1.8 μM and anticancer potential[14].

4.8 Uterotonic Activity

Methanolic extracts of stem bark stimulate uterine contractility via mechanisms that are independent of calcium and resemble oxytocin. Putative pathways implicate the release of prostaglandins, the H1-histamine and α-adrenergic receptors, and interference with the calcium channel. There is evidence from millennia of traditional low-dose use for labour induction to suggest that it is likely safe[27].

5. Conclusion

According to the literature, the plant *D. cinerea* is an important medicinal plant having diverse pharmacological activities. Phytochemical studies indicated the presence of flavonoids, polyphenols, saponins, alkaloids, terpenoids, and tannins, attributed to various bioactivities. These are antimicrobial, antioxidant, anti-inflammatory, analgesic, anti-plasmodial, bronchodilatory, diuretic, and uterotonic activities. Further, the inhibition of protein farnesyl transferase shows promise for anticancer applications. The plant operates via immunomodulation, radical scavenging, receptor modulation, cytokine suppression or enzyme inhibition, among others. These results substantiate the traditional use of this plant and warrant future studies for isolation of the active compounds, pharmacokinetic studies, and development of standardized herbal preparations.

6. Author Contribution

To recognize the author's participation, we highlight each contribution. Prabhakar: Conducted data mining and literature survey; contributed to manuscript preparation and initial drafting. Dr. A. Vijayalakshmi: Guided literature sourcing and overall article design; supervised the manuscript development. All authors have read and agreed to the published version of the manuscript.

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