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## Review Article

# A Comprehensive Review of *Coleus aromaticus* Encompassing its Botany, Phytochemistry and Pharmacological Potential

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## ABSTRACT

*Coleus aromaticus* (syn. *Plectranthus amboinicus*), also Indian borage, is a perennial medicinal herb of the family Lamiaceae, spread across tropical and subtropical areas, particularly in south and west India. With a strong oregano fragrance and tolerance towards diverse climates, it plays an important role in Ayurvedic and folk medicine. It is traditionally employed to cure respiratory disorders such as cough, asthma, and bronchitis, digestive problems, fever, and cardiovascular diseases. Pharmacological experiments have established its wide range of bioactivities such as antioxidant, antidiabetic, anticancer, antiviral, antiepileptic, antiurolithic, anthelmintic, and antiprotozoal activities. Most worthy of note are its antimicrobial and antimycobacterial activities, which are primarily due to its essential oils and bioactive compounds like thymol, carvacrol, eugenol, 1,8-cineole, rosmarinic acid, and other flavonoids and triterpenoids. These chemicals play an important role in its therapeutic value by mechanisms like free radical scavenging, inhibition of enzymes, and disruption of membranes in causative agents. The plant's high phytochemical content, traditional applications, and established pharmacological activity make it an attractive candidate for the creation of new plant-based therapeutics. As a potential source for emerging drug discovery in the era of increased antibiotic resistance and increased worldwide interest in natural medicines, *Coleus aromaticus* is an exciting prospect. This review underscores the necessity of additional clinical and mechanistic investigations to complete its therapeutic potential and confirm its traditional uses.

## INTRODUCTION

*Coleus aromaticus* (L.) Benth, synonymously *Plectranthus amboinicus*, is a perennial, succulent,

scented herb of the family Lamiaceae. Indian borage, country borage, Cuban oregano, or Mexican mint are other common names. Native to Southern and Eastern Africa, the plant is now

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extensively grown and naturalized throughout tropical and subtropical regions, including India, Southeast Asia, and the Caribbean [1]. In India, particularly in southern states, it is widely cultivated in kitchen gardens and used as both a flavouring herb and for medicinal purposes [2]. It is culturally significant in traditional medicine systems such as Ayurveda, Siddha, and Unani [3].

Traditionally, *C. aromaticus* has been used to treat respiratory illnesses (asthma, bronchitis, cough), gastrointestinal disorders (indigestion, flatulence, colic), and some cardiovascular conditions. Its leaves are applied topically for skin infections and bites; decoctions are taken for fever, sore throat, and urinary conditions [4]. In ethnoveterinary medicine, leaf extracts are administered to animals for digestive distress and appetite stimulation [5].

Pharmacological studies, including both in vitro and in vivo models, have documented a broad spectrum of bioactivities: antioxidant, anti-inflammatory, antimicrobial, antiviral, antidiabetic, anticonvulsant, anticancer, neuroprotective, antiurolithic, anthelmintic, and antiprotozoal effects [6,7]. These effects stem from its complex phytochemical profile, which comprises flavonoids (e.g. salvigenin, crisimaritin, chrysoeriol), phenolic acids (e.g. rosmarinic, caffeic, chlorogenic acids), terpenoids, saponins, alkaloids, and tannins [8]. Essential oils from the leaves contain high concentrations of antimicrobial monoterpenes and sesquiterpenes such as thymol, carvacrol, eugenol, 1,8-cineole, and  $\alpha$ -pinene [9].

The antimicrobial and antibacterial potential of *C. aromaticus* has gained renewed attention due to rising antibiotic resistance. Leaf extracts and essential oils have demonstrated inhibitory activity against a range of pathogens, including Gram-positive and Gram-negative bacteria, some fungi, and mycobacterial species [10,11]. Recent

mechanistic studies show that leaf extracts impair bacterial antioxidant systems, increase reactive oxygen species (ROS), disrupt membrane integrity, inhibit efflux pumps, and reduce catalase activity in *Pseudomonas aeruginosa* and *Staphylococcus aureus* [11]. Other investigations have shown that plant-mediated zinc oxide nanoparticles enhance antibacterial efficacy through green synthesis routes [12].

Analyses of geographical and seasonal variation in essential oil composition indicate significant differences in key constituents (e.g. germacrene D,  $\alpha$ -humulene,  $\alpha$ -terpinene, carvacrol), which influence antioxidant and antimicrobial potency [13]. A comparative study across different regions of southern Ecuador showed that essential oil composition and total phenolic content correlate with radical-scavenging capacity and antimicrobial activity [13].

Although multiple traditional and experimental studies support its efficacy, further standardized pharmacological investigations and formulation development are needed. Variations due to harvest season, environmental conditions, plant maturity, and extraction methodologies underscore the need for controlled studies to optimize therapeutic activity and ensure reproducibility [14].

Given its ethnobotanical value, rich phytochemistry, demonstrated antimicrobial action, and low toxicity, *C. aromaticus* is an excellent candidate for developing novel, plant-derived therapeutics—especially in combatting antimicrobial resistance [15]. Continued research into bioactivity-guided fractionation, detailed mechanism-of-action studies, and clinical validation may lead to affordable, effective antimicrobial formulations based on this traditional herb [16,17].



## TAXONOMY [18]

<b>Kingdom</b>	Plantae
<b>Subkingdom</b>	Tracheobionta
<b>Division</b>	Magnoliophyta
<b>Class</b>	Magnoliopsida
<b>Order</b>	Lamiales
<b>Family</b>	Lamiaceae
<b>Genus</b>	<i>Coleus</i>
<b>Species</b>	<i>Coleus aromaticus</i>

## VERNACULAR NAMES [19]

Language	Common Name(s)
<b>English</b>	Country borage, Indian borage
<b>Hindi</b>	Patta ajavayin
<b>Kannada</b>	Dodda pathre, Karpurahalli
<b>Malayalam</b>	Kannikkurkka, Panikkurkka
<b>Sanskrit</b>	Karpuravalli, Sugandhavalakam
<b>Tamil</b>	Karpuravalli, Omavalli

## DISTRIBUTION

*Coleus aromaticus* (syn. *Plectranthus amboinicus*), popularly called Indian borage or country borage, is an adaptable, fragrant, herbaceous plant with a wide range of geographical distribution in tropical and subtropical parts of the world. In India, it is cultivated as well as occurs naturally throughout different agro-climatic zones, testifying to its great adaptability as well as environmental hardiness. The species is most common in the western and southern states, such as Karnataka, Tamil Nadu, Kerala, Maharashtra, Andhra Pradesh, and Rajasthan (old name Rajputana) [20]. Its adaptability to all types of environmental conditions has led to its growth both in cultivated places and in the wild.

The plant occurs commonly on forest borders, rocky hill slopes, open grasslands, roadside spots, and urban home gardens and courtyards. It thrives in well-drained soils and can endure extensive sunlight exposures ranging from partial shade to full sunlight. The low maintenance needs of *C. aromaticus* render it a viable species for use in herbal nurseries, kitchen gardens, and public landscaping schemes [21]. Its high viability and medicinal properties also guarantee continued cultivation by rural and urban communities.

Beyond India, *C. aromaticus* has also gained a good presence in a number of other regions in the world. It is generally cultivated and naturalized in Southeast Asia (Sri Lanka, Indonesia, Thailand, and the Philippines), Eastern and Southern Africa, and a range of Caribbean islands. In all these places, much as in India, it has a significant position in traditional medicine and cuisine [22, 23]. In Africa, to cite but one instance, it is utilized as a medicinal herb for respiratory and gastrointestinal disorders, whereas in the Caribbean, it is prized both as a traditional remedy and flavoring herb in native cuisine [24].

The global distribution of *C. aromaticus* is largely driven by its ethnobotanical significance, ease of propagation, and therapeutic versatility. It is frequently propagated through stem cuttings, which root quickly in moist soil without requiring specialized care. This vegetative propagation method has facilitated its spread across continents and allowed it to adapt to a variety of climates and ecosystems [25–27].

## DESCRIPTION OF THE PLANT [28]





**Fig. 1: *Coleus aromaticus* plant**

*Coleus aromaticus* (syn. *Plectranthus amboinicus*) is a succulent, perennial, aromatic herb belonging to the family Lamiaceae. It is native to Africa but widely cultivated across India and other tropical regions for its medicinal, ornamental, and culinary uses. The plant is well known for its strong oregano-like fragrance and robust adaptability to varied agro-climatic conditions.

#### **Habit and Habitat:**

The plant typically attains a height of 50–100 cm and is characterized by its fleshy, pubescent structure. It thrives in warm, humid environments and is commonly found in home gardens, herbal plots, and along the edges of agricultural fields.

#### **Leaf:**

The leaves are opposite, simple, and ovate to broadly ovate in shape, measuring approximately 5–10 cm in length and 4–8 cm in width. They are thick, succulent, and densely pubescent, covered with fine velvety hairs. The leaf margins are prominently crenate or coarsely serrated. When crushed, the leaves release a strong, pungent aroma attributed to their rich essential oil content. This characteristic scent plays a key role in the plant's medicinal and culinary applications.

#### **Stem:**

The stems are fleshy, quadrangular in cross-section—a distinctive trait of the mint family—and range from green to purplish in color. They are covered with fine hairs and are relatively soft and

brittle in younger plants, allowing for easy vegetative propagation through stem cuttings. As the plant matures, the basal portions of the stem may become semi-woody to support structural growth.

#### **Bark:**

Being a herbaceous plant, *C. aromaticus* does not possess a true bark. However, with age, the basal stem becomes slightly woody and develops a thin, brownish, rough outer layer that serves as a protective support tissue.

#### **Inflorescence and Flower:**

The plant bears flowers seasonally on terminal spikes that measure 10–15 cm in length. The flowers are small (about 1–1.5 cm long), tubular, and bilabiate, displaying a characteristic two-lipped structure typical of the Lamiaceae family. The corolla is bluish-purple to pale violet and mildly fragrant, attracting a variety of pollinators such as bees and butterflies. Flowering typically occurs in warm seasons, depending on climatic and environmental conditions.

#### **Fruit and Seed:**

The fruit is a small, dry schizocarp that splits into four-minute nutlets upon maturation, each measuring around 1–2 mm in size. However, in many cultivated varieties, seed formation is limited, and the plant is primarily propagated through stem cuttings. When viable, the seeds

require warm, moist conditions and loose, well-drained soil to germinate successfully.

### Propagation:

Due to its succulent and brittle stems, *C. aromaticus* is most commonly propagated vegetatively through stem cuttings. This method ensures genetic consistency and rapid growth, making it the preferred choice for domestic and commercial cultivation.

### ACTIVE CONSTITUENTS [29]

*Coleus aromaticus* (syn. *Plectranthus amboinicus*) has gained significant pharmacological interest due to its rich phytochemical profile. Its essential oil contains major constituents such as thymol, carvacrol, eugenol, 1,8-cineole (eucalyptol), caryophyllene, methyl eugenol, phellandrene, terpinolene,  $\alpha$ -pinene, and  $\beta$ -pinene, all of which exhibit broad-spectrum antimicrobial activity. Additionally, its methanolic and chloroform extracts contain important flavones like

salvigenin, chrysoeriol, and crisimaritin, which contribute to its antioxidant and antibacterial potential. Polyphenolic compounds such as rosmarinic acid, chlorogenic acid, caffeic acid, and coumaric acid have also been identified, which are known for their strong free radical scavenging activity. Triterpenic acids like 2,3-dihydroxylean-12-en-28-oic acid, 2,3,19-trihydroxyurs-12-en-28-oic acid, and 2,3,19,23-tetrahydroxyurs-12-en-28-oic acid have been reported from the leaves, further enriching the plant's therapeutic profile. Studies also revealed the presence of volatile compounds isolated via steam distillation and GC-MS, with seasonal variations influencing the yield and composition of the essential oil—carvacrol and  $\beta$ -caryophyllene being predominant in oils extracted post-monsoon. Given its wide spectrum of bioactive constituents and synergistic effects with conventional antibiotics, *Coleus aromaticus* serves as a promising natural source for the development of novel antimicrobial agents amidst rising global concerns over antibiotic resistance.

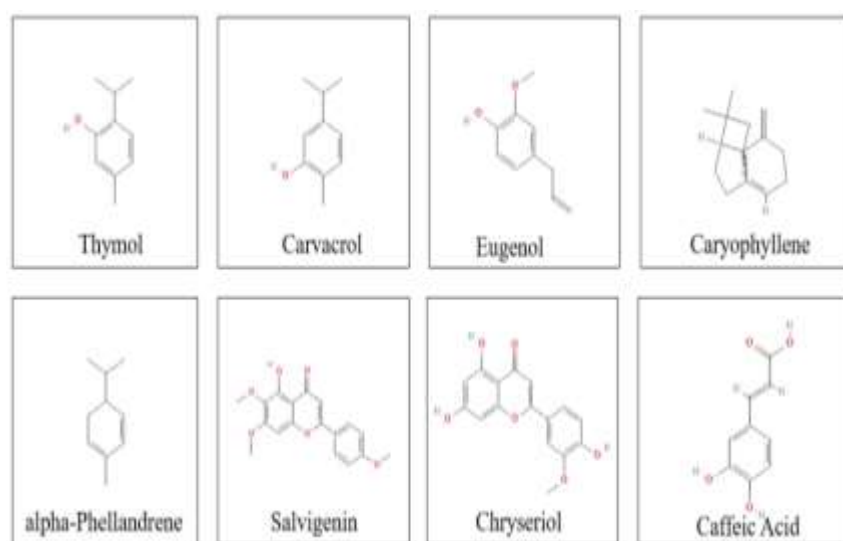


Fig. 2: Phyto-Chemical Constituents of *Coleus aromaticus*

### TRADITIONAL USES [7]

*Coleus aromaticus* (syn. *Plectranthus amboinicus*) has long been used in traditional medicine around the world. It is prized for managing convulsive

disorders such as epilepsy, where fresh leaf juice is administered as a calming antispasmodic [30]. The plant is also used to stimulate liver function and treat sluggish digestion, biliousness, and colic [31].

In urological applications, *C. aromaticus* is employed to treat renal and bladder stones, strangury, urinary tract infections, and other related complaints. Its leaves are traditionally regarded as antilithiatic—helping dissolve or prevent the formation of urinary calculi [31, 32]. In gynecology, leaf preparations are used for vaginal discharges and other female reproductive ailments [31].

Beyond these, it is used in managing fevers, dysentery, cholera, gonorrhoea, and even the toxic effects of poisonous bites. In pediatric care, leaf juice mixed with sugar is a common remedy for colic or gas in infants. Externally, bruised leaves are applied to relieve headaches, and poultices or eye instillations are used for conjunctivitis and minor eye irritations [30, 32, 33].

The plant is described broadly as antispasmodic, cathartic, stimulant, and tonic. Its traditional therapeutic profile includes uses as a carminative, analgesic, antipyretic, and lactagogue, notably in promoting breast milk production and relieving postpartum ailments [30–34]. In many regions, it remains a trusted household remedy and is being revisited in modern phytopharmacology for its diverse bioactive constituents and therapeutic potential [30, 34, 35].

## PHARMACOLOGICAL USES

### a) Antioxidant activity [36]

*Coleus aromaticus* exhibits strong antioxidant properties due to its rich content of bioactive compounds like carvacrol, flavonoids, rosmarinic acid, caffeic acid, and chlorogenic acid. These compounds help prevent lipid peroxidation, oxidative stress, and DNA damage. The plant extracts—especially ethanolic and hydroalcoholic—have been shown to reduce total phenolic and flavonoid content under oxidative

stress and exhibit radical-scavenging activity in DPPH assays. Its antioxidant potential contributes to anticancer, anti-inflammatory, and radioprotective effects, making *C. aromaticus* a valuable natural source for nutraceutical and pharmaceutical applications.

### b) Antiepileptic activity [37]:

*Coleus aromaticus* exhibits antiepileptic and anticonvulsive properties due to its rich content of bioactive compounds like alkaloids, flavonoids, and saponins. Studies have shown that alcoholic extracts of its leaves, stem, and roots help manage nervous disorders such as epilepsy and convulsions. Experimental models using mice subjected to chemically and electrically induced seizures confirmed its anticonvulsant potential, supporting its traditional use in treating neurological conditions.

### c) Antiviral activity [38]:

*Coleus aromaticus* leaf extracts prepared in solvents like hexane, ethanol, and chloroform exhibit strong antiviral activity against various viruses including Bombyx mori Nuclear Polyhedrosis Virus (BmNPV), Herpes Simplex Virus-1 and 2 (HSV-1 & HSV-2), and Vesicular Stomatitis Virus (VSV). Ethanol extracts showed antiviral effects on Vero cell lines, while leaf juice also demonstrated anti-HIV activity. These findings confirm the broad-spectrum antiviral potential of *C. aromaticus* leaf extracts.

### d) Antiprotozoal activity [39]:

*Coleus aromaticus* demonstrates notable antiprotozoal activity. In vivo studies showed its effectiveness against *Plasmodium berghei* infections in mice by significantly reducing parasitemia, indicating antimalarial potential. Aqueous and methanolic extracts were also



effective against protozoa like *Leishmania braziliensis*, *L. chagasi*, and *L. amazonensis*. The essential oil and methanolic extract of the plant reduced the viability of these parasites, supporting its use in treating protozoal infection .

#### e) Anticancer activity [40]:

*Coleus aromaticus* shows strong anticancer properties through various mechanisms. Its hydroalcoholic, ethanolic, and hexane extracts reduce tumor growth and induce apoptosis in cancer cells with fewer side effects compared to standard chemotherapy drugs. Key compounds like thymoquinone and carvacrol help suppress inflammatory markers and trigger cell death through mitochondrial pathways. Additionally, nanoparticles synthesized using its leaf extract have been successfully used to deliver genetic material (miRNA) to lung cancer cells, enhancing therapeutic effectiveness. Overall, it demonstrates cytotoxic, antiproliferative, and tumor-inhibiting effects, making it a promising natural agent for cancer treatment.

#### f) Activity Against cardiovascular disorder [41]:

*Coleus aromaticus* has shown beneficial effects in cardiovascular health, particularly in managing congestive heart failure. Aqueous extracts of its fresh leaves exhibit a positive inotropic effect, meaning they strengthen heart contractions without altering the heart rate. This action is believed to result from increased sodium influx, which boosts intracellular calcium availability—essential for stronger heart muscle contractions. Extracts from tissue-cultured plants also demonstrate similar heart-supportive properties, indicating their potential in promoting cardiac function and maintaining heart health.

### FUTURE DIRECTIONS

*Coleus aromaticus* is a highly promising therapeutic agent whose potential is yet to be realised through the limited degrees of scientific validation. An important area to invest in future research is in the standardisation of its phytochemical constituents. The herb has a diverse array of bioactive compounds like thymol, carvacrol, and rosmarinic acid, whose contents differ according to geography, climate, and growing conditions. Standardized extraction protocols will be developed, as well as quality control standards, to ensure that both clinical and research applications are uniform.

Preclinical and clinical trials must be increased. Although the plant has shown considerable pharmacological activities in vitro and in animal models, human clinical studies are limited. Targeted studies on its efficacy in diseases like epilepsy, asthma, kidney stones, and gastrointestinal disorders can prove its traditional uses. Safety, range of dosage, pharmacokinetics, and long-term tolerability can be evaluated in these trials.

Knowledge of the molecular mechanisms through which the therapeutic activity of *C. aromaticus* occurs is critical. Studies need to determine how its constituents affect biological targets—be it by modulation of inflammatory cascades, neurotransmitter functions, or antimicrobial functions. Current analytical tools such as molecular docking, gene expression profiling, and proteomics can give important insight into these processes and assist in the identification of new therapeutic routes.

Innovations in drug delivery technology provide potential new paths for development. Because of the unstable and hydrophobic properties of many of its key essential oils, nanoformulations and encapsulation methods might improve their stability, solubility, and bioavailability. This might



help targeting neurological, respiratory, and gastrointestinal disorders where localized or sustained release is required.

There is potential for incorporating *C. aromaticus* into contemporary therapeutic regimens in combination with traditional drugs. Such incorporation may enhance treatment efficacy, minimize drug side effects, and facilitate a more holistic management of chronic disease. Thorough studies of herb-drug interactions and metabolic pathways are required to provide assurance of safety in polypharmacy scenarios.

The increasing popularity of *C. aromaticus* highlights the significance of sustainable cultivation and conservation. Organic farming, community-based cultivation schemes, and propagation methods such as tissue culture can be encouraged to satisfy increasing demand without harming natural populations. Ethical sourcing and ecologically friendly practices are key as demand for this medicinal plant continues to escalate.

## CONCLUSION

*Coleus aromaticus* is a botanically valuable aromatic herb known for its thick, fleshy leaves and strong oregano-like scent. Phytochemically, it is rich in bioactive compounds such as flavonoids, terpenoids, essential oils, thymoquinone, and carvacrol. Pharmacologically, it exhibits a wide range of therapeutic activities, including antioxidant, antimicrobial, anti-inflammatory, antiepileptic, anticancer, antiparasitic, and cardioprotective effects. Its traditional use and modern research highlight its potential as a multifunctional medicinal plant with significant health-promoting properties.

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