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# MEDICINALLY IMPORTANT *COLEUS* SPECIES, *COLEUS MALABARICUS* BENTH. AND MANY OTHERS OF FAMILY LAMIACEAE FROM THE WESTERN GHATS, INDIA - A REVIEW

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**Keywords:**

*Coleus bishopianus*, *Coleus caninus*, *Coleus fruticosus*, *Coleus malabaricus*, *Coleus mollis*, *Coleus paniculatus*

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**ABSTRACT:** India is renowned for its rich biodiversity and the Western Ghats, because of its varied topography and ecological conditions support a very rich flora including medicinally valuable aromatic and non-aromatic plant species. The Western Ghats are additionally documented for diversity within the ethnic communities; they have been utilizing the plant wealth for medicinal purposes and have proven successful for generations. *Coleus*, one of the largest genus of the family Lamiaceae, is well known for its aromatic medicinal plants of ethnomedicinal importance. Among the different species within the genus, *Coleus amboinicus* and *Coleus barbatus* are the most documented species with a wide variety of traditional medicinal uses in ayurvedic as well as folklore medicine. Even though the plants such as *Coleus malabaricus*, *Coleus mollis*, *Coleus urticifolius*, *Coleus fruticosus*, *Coleus bishopianus*, *Coleus paniculatus* and *Coleus caninus* of the Western ghats reported to possess enormous ethnomedicinal uses, very little is known regarding the chemical constituents and biological activities of these species. Numerous new species have additionally been recognized from this area. This article provides a comprehensive look at these species and presents it in a concise manner for the researchers with the aim of future bioprospecting of these potential medicinal plants. The article is also emphasizing the importance of the conservation of potential medicinal plants of the Western Ghats and the need of multiplication of these species including endangered and endemic species through the application of modern biotechnological tools.

**INTRODUCTION:** Since the dawn of civilization medicinal plants are used for the cure of a range of human ailments. Owing to the unmatched availability of biodynamic constituents, natural products from medicinal plants either as pure compounds or standardized extracts provides unlimited opportunity for modern drug development.

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The emergence of the science of phyto-pharmaceuticals and the hopes for remedies in chronic diseases generated new enthusiasm in the research workers to exploit herbal medicines [1].

Lamiaceae (earlier known as Labiatae), is the largest family among dicotyledons with a strength of about 236 genera and 6,900-7,200 species. It is one of the most diverse and widespread plant families with a cosmopolitan distribution in the world but concentrated more on the Mediterranean region, Indo Malaysian region and Australia [2]. Most of the plant members are herbs or under shrubs and produce a high amount of essential oil that enables them to survive the hot summer season.

Owing to the ease of cultivation by vegetative propagation method and ethnomedicinal, horticultural, and culinary importance many members of the plant family are widely cultivated around the world [3]. *Coleus* is one of the largest genera of Lamiaceae and is found to be distributed through tropical and warm regions like Africa, Australia, and India [4]. The genus name *Coleus* was first described in 1790 by Loureiro from the Greek word 'Coleos', which implies sheath. The Genus *Coleus* comes under the subfamily Nepetoideae of tribe Ocimeae and subtribe Plectranthinae. Owing to the lack of clear cut morphological criteria for identification of different species within the genera, there existed numerous taxonomic problems in the naming of *Coleus* species and species have often been placed in closely related genera like *Plectranthus*, *Solestemon*, *Englerastrum*. Paton *et al.*, proposed a synopsis of the genera *Coleus* Lour, *Equilabium* A.J Paton & Mwany and *Plectranthus* L'Her. In this 212 names are changed to combinations in *Coleus* from *Plectranthus* based on the calyx and corolla morphology and treated *Coleus* as distinct from *Plectranthus* by having four stamens fused together rather than free to their base [5].

Even though, the genus has importance in the horticultural and floricultural aspect, 85% of the documented uses of *Coleus* are medicinal. The wide variety of disease conditions that can be treated with *Coleus* is an indication of the medicinal value of the genus. Most of the species are non-toxic and so may be taken orally others are used topically for various skin conditions, as inhalations or as enemas [6].

Among the different species, *Coleus amboinicus* (*Plectranthus amboinicus*), *Coleus barbatus* (*Plectranthus barbatus, Coleus forskalaei*) accounts for about 68% of all traditional uses of the genus [3, 6]. Ethnobotanical uses of the genera include treatment of digestive disorders, skin conditions, respiratory conditions, infections and fever, genitourinary conditions, and musculoskeletal conditions. Flavonoids, glycosides, phenolic compounds, and volatile constituents have been reported from various *Coleus* species. The aromatic nature of the plants belonging to the genus is attributed to essential oil production. Isolated diterpenoids and abietane diterpenoids, triterpenoids of the essential oil is mainly responsible for different pharmacological activities such as antibacterial, antifungal, antitumor, and these compounds make *Coleus* an important genus for drug development. Owing to these reasons, more than 500 varieties of *Coleus* species are cultivating throughout the World nowadays. In spite of the worldwide distribution of the species, the chemistry and biological activities of so many species have to be studied more deeply [4, 6].

Lukohoba *et al.,* provided a comprehensive understanding of the global ethnobotany of the plants coming under the genus [6]. Rice *et al.,* offered an updated horticultural and ethnobotanical review of the South African species [7]. The chemistry of Indian species was reviewed by Waidia *et al.* [8]

The review is an attempt to summarize uptodate information and hidden potential of the underutilized medicinal plants belonging to the genus *Coleus* found in the Western Ghats region of India such as *Coleus malabaricus, Coleus mollis, Coleus urticifolius, Coleus fruticosus, Coleus bishopianus, Coleus caninus,* and *Coleus paniculatus*. India is well known for its rich biodiversity and the Western Ghats contribute well. The tribal communities in these biodiversity rich areas possess a wealth of knowledge on the utilization and conservation of food and medicinal plants. This knowledge has been passed from one generation to another without a written document. The rich biodiversity of the Western Ghats is also under considerable threat from various human activities [9]. This article also highlights the importance of the multiplication of medicinally valuable endangered and endemic species through the application of modern biotechnological tools. Relevant literature on the taxonomic history, distribution, local name, ethnobotanical uses, therapeutic and biological activity studies of these species were collected from various texts and research publications. Besides, the present comprehensive documentation would thus provide vital information for the bioprospecting of these plant species.

**Medicinally Important *Coleus* from the Western Ghats:** India is one of the 12 mega diversity countries of the world, where the Western Ghats is one of the tropical evergreen forested regions and

occupy enormous plant diversity. Western Ghats or Sahayiadris form a sequence of mountains parallel to the west coast stretching from Kanyakumari in the south to Tapthi river in the north masking a total region of about 160,000 $Km^2$. It lies between 22º N to 80º N and covering the Western border of the states of south Gujarat, Maharashtra, Karnataka, Tamil Nadu and Kerala. The significant variation in the ecological condition of the Western Ghats helps the growth of a rich range of aromatic vegetation. The family Lamiaceae is with its topmost position. Infraspecific diversity, because of the wide variation in habitat situations in the Western Ghats can be the clean-cut reason for the far spread distribution of fragrant species, enormous morphological variation and genetic diversity within the species in this region. The aromatic and non-fragrant plant life from this vicinity is utilized ethnobotanically by the tribal communities of this area for treating their ailments after centuries of trials. The fragrant flora from this area may be exploited for the perfumery and pharmaceutical industries. About 1286 species of different genera are endemic to the southern Western Ghats alone [9].

Medicinally important coleus species found in south Western Ghats include *Coleus amboinicus, Coleus mollis, Coleus barbatus, Coleus coleoides, Coleus deccanicus, Coleus subincisus, Coleus bishopianus and Coleus beddomi.* Among these *Coleus amboinicus* and *Coleus barbatus* are well studied and well documented and account for 68% of all the traditional uses of the genus [6]. This review mainly focuses on the underutilized ethnomedicinally important species of the Western Ghats than the well-studied and well-documented species *Coleus amboinicus* and *Coleus barbatus* because not enough is known about the chemistry and pharmacological activities of these species to explain their traditional uses.

***Coleus amboinicus*** **Lour.:** Most commonly used Synonyms of the plant is *Coleus aromaticus* Benth, *Plectranthus amboinicus* (Lour.) Spreng [5]. This is the plant among the genus *Coleus* with greater synonyms and local names. *Coleus amboinicus* is commonly known as Indian borage, Country borage, Cuban oregano, French thyme, Indian mint, Mexican mint, Soup mint, Spanish thyme. Common names in Malayalam are Kannikkurkka, Panikkurkka, in Sanskrit are Karpuravalli, Sugandha Valakam and in Tamil are Karpuravalli, Omavalli. It is a large succulent perennial, branched aromatic herb with approximately 30–90 cm in height and with thick fleshy stem and leaves [10]. It is one of the most cited and well-documented species in the Lamiaceae family, which occurs naturally throughout the tropics and warm regions of Africa, Asia, and Australia, where it is used as traditional medicine, spice, and ornamental plant [11].

In folklore medicine, the plant is used to treat conditions like cold, chronic asthma, constipation, headache, cough, fever, skin diseases, malarial fever, hepatopathy, renal and vesical calculi, hic-cough, bronchitis, helminthiasis, colic, convulsions, and epilepsy. Studies have revealed the occurrence of 76 volatile and 30 non-volatile compounds belonging to different classes of phytochemicals such as monoterpenoids, diterpenoids, diterpenoids, sesquiterpenoids, phenolics, flavonoids, esters, alcohols, and aldehydes. The major chemical compounds found in the essential oil of *Coleus amboinicus* are phenolic monoterpenes like carvacrol and thymol. Other components include α-humulene, undecanal, γ-terpinene, p-cymene, caryophyllene oxide, α-terpineol, β-selinene, 1,8-cineole, eugenol, caryophyllene, terpinolene, α-pinene, β-pinene, methyl eugenol, and β-phellandrene. Studies have cited numerous pharmacological properties, including anti-microbial, anti-inflammatory, antitumor, wound healing, antiepileptic, larvicidal, antioxidant, and analgesic activities, and also in the treatment of respiratory, cardiovascular, oral, skin, digestive, and urinary diseases [6, 11].

***Coleus barbatus*** **Andrews: Synonyms:** *Plectranthus barbatus, Coleus forskalaei* [5].

*Coleus barbatus* is an important medicinal plant native to India. Also seen in Tropical east Africa, West Asia, Nepal, Bhutan, Srilanka, South China, and Thailand [13]. The plant is commonly known as *Coleus* or Indian *Coleus* and is recorded in Ayurvedic Materia medica under the Sanskrit name Makandi and Mayani [12]. The plant grows on rocky surfaces in forest openings at an elevation of 500-2100m. In India, only a small variety of *C. barbatus* is seen [13]. *C. barbatus* is a perennial aromatic herb with a height up to 45-60 cm. The

stem is 4-angled, branched with hairy nodes. The roots are fascicular, thick, fibrous, radially spreading, and golden brown in colour and strongly aromatic. Leaves are 7.5 to 12.5 cm in length and 3 to 5cm in width, slightly pubescent, narrowed into petioles. The inflorescence is a raceme, 15-30 cm in length, flowers are stout, 2-2.5 cm in size, usually perfect and calyx hairy inside. Upper lip of calyx is broadly ovate. The blue or lilac corolla is bilabiate. Lower lobes are elongated, concave and enclose the essential organs. The leaves and tubers have quite different odours. Similarly, the root morphology varies in different populations may be tuberous, semi tuberous or fibrous (Non-tuberous) [12, 13].

The whole plant has been a rich source of various phytoconstituents like monoterpenes, diterpenes, sesquiterpenes, glycosides and phenolic glycosides. Primary constituent of clinical importance isolated from the root is a labdane diterpene Forskholin (Colenol). Other diterpenoids like isoforskholin, 1-Deoxy forskholin, 1,9-Dideoxyforskholis, 13-epi-salareol found in almost all parts, but roots are the major source. Phytoconstituents like barbatusin, cyclobarbatusin, methelene quinine, and coleon is present in the leaves. Essential oil after GC-MS analysis showed the presence of ∞-pinene in the leaves, (Z)-β-ocimene in the roots, and β-phellandrene in the stem. Recently, two new labdanediterpene glycosides forskoditerpenoside A and B were also isolated from the ethanol extract of the whole plant [6, 8].

The plant has been used in the treatment of eczema, asthma, psoriasis, cardiovascular disorders and hypertension, skin infections, cardiac complaints, piles, urinary complaints, epilepsy, insomnia, *etc*. It is reported to have anti-aging, antioxidant, anti-obesity, and anti-depressant activities. Forskolin, is an important labdane diterpenoid that is extracted from the roots of the plant activates an enzyme adenylate cyclase, which increases cyclic adenosine monophosphate (cAMP) levels in cells, which is the most important cell-regulating compound results in inhibition of platelet activation, increased force of contraction of heart muscle, relaxation of smooth muscle, increased insulin secretion and increased thyroid function. *Coleus* also increases cerebral blood flow, so found to be beneficial in cerebral vascular insufficiency and in enhancing post-stroke recovery and in the treatment of Glaucoma. Forskolin is also used in the preparation of medicines for preventing hair graying and restoring gray hair to its normal colour [12, 14].

***Coleus malabaricus* Benth.:** Currently, the accepted botanical name of this medicinal plant is *Coleus malabaricus* Benth. All other names mentioned in the literature for this are treated as its synonyms.

**Synonyms:** *Plectranthus malabaricus* (Benth.) R. H. Willemse, *Coleus macraei* Benth, *Coleus ovatus* Benth, *Coleus leptostachys* Benth, *Plectranthus malabaricus* var. *leptostachys* (Benth.), *Coleus walkeri* Benth [5].

**Local Names:** The plant's local name in different languages is not included in any traditional manuscripts. Most of the names mentioned in the review are collected from the survey reports of tribal communities of different localities mentioned in various literature. Indian name: Ellambi [15, 16]. Tamil: Kurali [17], Periyathulasi [18], Malayalam: Parakkoorka [19], Kattuthulasi, Kattappa by the tribes of Wayanad region, Kerala.

**Botanical Information:** Gamble described the plant as a large erect herb reaching 3 feet, with often purple stem and leaves. Flowers pale lilac with dark blue upper lip [20]. Sasidharan described the plant as herbs with quadrangular purplish stem. Leaves 15 × 13 cm, puberulous, ovate, obtuse or acute, leaf base is truncate or subcordate. Panicles terminal to 30 cm long. Calyx striate, upper lip broadly ovate, lower 3-lobed, lobes ovate-lanceolate. Corolla white with a purple tinge, 1 cm long. Stamens exserted, filaments glabrous [21]. Mathew *et al.*, compared the morphological characters of the plant *Coleus malabaricus* with morphologically similar new species collected from Western Ghats, *Coleus idukkianus* (*Plectranthus idukkianus*) and *Coleus saxorum* and described the plant as an herb, erect or prostrate, highly variable, perennial up to 150 cm tall. Stem 4-angled, slightly puberulous purplish, quadrangular, branched. Leaves ovate, obtuse or acute, base truncate or subcordate, puberulous, to 15 × 13 cm., margin mainly crenate, upper surface glabrous or pubescent with simple hairs, lower surface purplish with red glandular dots, petiole upto100 mm long.

Inflorescence basally branched thyrsi of 30 cm long, slightly puberulous peduncle, lax dichasia with 5-7 flowers.

Panicles terminal, to 30 cm long. Calyx striate, upper lip broadly ovate, lower 3-lobed, lobes ovate-lanceolate. Corolla white with a purple tinge, 1cm long. stamens exserted, filaments glabrous [22]. The comparative study is valuable in the easy identification of the plant with the other two species since all are found in the same locality.

A detailed taxonomic description of the plant was given by Smitha and Sunoj and reported that *Coleus malabaricus* is a highly polymorphic species and exhibits extreme morphological variation. They have collected more than eight different polymorphic species from different localities of the Western Ghats like Thusharagiri, Kodajadri, Thollayiram forest, Kuricherimala, Vagamon, Sholayar, Parambikulam. All these accessions showed differences in the vegetative characters but the floral characters were the same [13].

Flowering and fruiting time of the plant is August to December. The plant is globally distributed in South India and Srilanka. South India the plant is reported form Cannore, Kottayam, Thiruvananthapuram, Wayanad, Kollam, Kasargod, Palaghat, Thrissur, Wayanad, Malappuram, Pathanamthitta, Idukki districts of Kerala, Hassan, Shimoga, Banglore, Chikamaglore of Karnataka and Coimbatore, Kanniyakumari, Dindigul, Nilgiri, Theni, Tiruchchirappalli, Tirunelveli, Kodaikanal regions of Tamil Nadu [21, 23] .

The plant is commonly seen in Shola forest (Montane evergreen forest) in shady areas [13]. The plant is found in the evergreen forest of the Western Ghats and the Eastern Ghats at an altitude ranging from 700-1200 m [21]. According to Gamble, the plant is found near the rocky regions inside the forest, especially in the marshy places, and the plant is mainly found in the Western Ghats, Nilgiris, Puleney hills, Hills of Travancore and Tinnavelly upto 6,000 Feet [20]. Bushana in the biodiversity portal of Srilanka described the plant found in Srilanka as a large indigenous herb restricted to shady places near streams in secondary submontane forests from 640 to 1400 m elevations. Rarely also occurs in wet lowland forests, and flowering is seen throughout the year [24].

**Ethnobotanical Uses:** An ethnobotanical survey report on Kurumba tribes of Nilgiri district of Tamil Nadu revealed that the plant is used by the tribes under the name Periya Thulasi and is used for the treatment of asthma by applying the leaf paste on the chest or vapour of the leaf is boiled in water and inhaled like Sacred Basil (*Ocimum sanctum*, Tulsi) [18]. Ethnobotanical survey of Irula tribal settlements in forest areas of Chengal, Combai, and Coonoor of the Nilgiris showed that the tribes have been using the leaf juice orally under the local name Ellamabai for the smooth functioning of the heart and the authors reported that the tribes are also using this plant to prevent heart attack [16].

A study conducted on the folklore medicinal uses of some indigenous medicinal plants among the tribes of Nilgiri's south, Shola division of Western Ghats documented that the tribal communities of these areas use the seeds of the plant for the treatment of cough and cold under the local name Kurali [17]. The whole plant is made into a paste and applied knots for curing muscular pain [15]. Major medicinal species of *Coleus* found in India are *Coleus forskohli, Coleus amboinicus, Coleus malabaricus, Coleus scutellaroides* and are used for the treatment of dysentery and digestive conditions [25].

**Non-medicinal Uses:** The tribes of Wayanad also use the plant for its insect repellent activity. The whole plant or the crushing plant is placed indoor to keep away mosquitos.

**Antimicrobial Studies:** Antimicrobial screening of hydrodistilled essential oil from *Coleus malabaricus* Benth. var. *mollis* (Benth.) were performed against bacteria *Bacillus subtilis*, *Bacillus megaterium*, *Escherichia coli*, *Pseudomonas aeruginosa*, *Proteus vulgaris*, and Fungi such as *Rhizopus oryzae*, *Rhizoctonia*, *Oryzae sativae*, *Aspergillus niger*, *Aspergillus parasiticus*, *Fusiarum solani*, and *Candida albicans.* The results showed that *Bacillus subtilis*, *Pseudomonas aeruginosa,* and *Aspergillus parasiticus* were almost completely resistant against the undiluted oil. Comparatively, large inhibition zones were obtained, and the essential oil was found to be more active than the standard drug against *Bacillus megaterium*, *Escherichia coli*, and *Rhizopus* oryzae [26].

*Coleus amboinicus, Coleus canisus, C. blumei, C. parviflorus, C. malabaricus,* and *C. spicatus* were assayed semiquantitatively for the presence of Forskholin by using TLC and GLC assay methods and reports showed that Forskkohlin occurred exclusively in *Coleus forskohli* and could not be present in six other species [27].

***Coleus mollis* Benth:**

**Synonym:** *Plectranthus crameri* R. H Willemse [5]. Formerly *Plectranthus incanus* and *Plectranthus cordifolius* were also used as a synonym for plant [13].

**Common Name:** Kala basing [8], Soft-Stem Mintleaf, Heart-leaved Mint leaf.

Malayalam- Perim-tolassi, Kannada- Nonadakasa, Marathi- LalAghada, Nepali- Guhyasilam, Oriya- Gondri [21].

The plant is a small, erect, fleshy, annual herb; growing up to 30-50 cm tall. Stem quadrangular, flaccid, sparsely pubescent. Leaves Opposite, broadly ovate, 3-11 × 3-9 cm, acute apex, base cordate, margin dentate, sparsely pubescent. Petioles 3-8 cm long.; Inflorescence terminal cymose or panicles, 7-23 cm long. Flowers are borne in branched racemes. Flowers are pale blue carried on 3-4 cm long stalk. Corolla purplish; tube c. 2 mm long, slender, inflated above; lower lip small, obtuse, upper lip elongate. Calyx cup is 2-lipped. Calyx 2-3 mm long, 2-lipped. Swelling of the mature fruiting calyx tube caused by the large nutlets, upper lobe foliaceous, obtuse. Fruits are round, 2-3 mm, brown, purple spots on mericarp. Nutlets 4, oblong, smooth [13, 21].

The plant is globally distributed in Nepal, Burma, India [13] and Sri Lanka [5]. General habitat is the grass lands. Flowering and fruiting time is during August-November. In India, the plant is reported from the Himalayas and Kerala (Alappuzha, Kasaragode, Kollam, Thiruvananthapuram, Malappuram), Maharashtra, Karnataka (Belgaum, Chikmagalur, Coorg, Dharwar, Hassan, Mysore, N. Kanara, Shimoga), Tamil Nadu (Coimbatore, Dharmapuri, Dindigul, Madurai, Nilgiri, Salem, Tiruvannamalai, Viluppuram) [23].

The plant has a wide range of applications in folklore medicine. It is used as an antidote, anti-rheumatic, astringent, cardiac tonic, styptic, febrifuge, and vasoconstrictor. The hydroalcoholic extract has shown antioxidant activity. The plant is believed to have the ability to restore normalcy in coma patients and also treat trauma in children [6, 28]. The plant is also used as a respiratory stimulant to treat conditions such as hemorrhages, mental retardation, skin conditions, and snakebites. The plant is reported to exhibit relaxant activity on smooth and skeletal muscles and has cytotoxic and anti-tumour activity. So it can be used for the treatment of cancer [29]. The crushed leaves are used to stop bleeding and to cure fever. The leaves and flowering tops contain an essential oil (0.2 ml/100g.). The activity of 10 mg of the oil was found to be the same as that of 10 units of penicillin G sodium. The essential oil also exhibited cardiac depressants, respiratory stimulants, and good antimicrobial activity. The chloroform extract of the leaves has shown anti-inflammatory activity. The leaves and flowering tops contain resin and tannin. Hydro distillation of the fresh plant leaves gave an essential oil with a yield of 0.62% (w/v). The major components of the oil are fenchone, cis-piperitone oxide, piperitone, Piperitenone oxide, beta-caryophyllene, alpha-cadinene, borneol, delta-cadinene, alpha-humulene, beta-bisabolene, alpha-copaene [28].

**Other Uses:** The seeds are fried in mustard oil and then massaged all over the body as an insect repellant [29]. The crushed leaves are used as a mosquito repellant. The essential oil obtained from the plant has shown good mosquito repellent activity and also acts as a strong mosquitocidal agent [28].

Ramu *et al.,* conducted Pharmacognostical, Physicochemical, and preliminary phytochemical studies on the leaves of *Coleus mollis* [28].

Joshi *et al.,* isolated essential oil from the flowering aerial parts of *Coleus mollis* by the hydro-distillation method and analyzed by gas chromatography coupled with flame ionization (GC-FID) mass spectrometry (GC/MS) techniques. Twenty-seven compounds were identified. The main compound identified was fenchone followed by α-humulene, piperitenone oxide, cis-piperitone oxide, and E-β-farnesene. The oil was found rich in oxygenated monoterpenes-type constituents followed

by sesquiterpene hydrocarbons, oxygenated sesquiterpenes, and monoterpene hydrocarbons. The authors also carried out the antimicrobial screening of the essential oil of *P. mollis* against six gram-positive and eight gram-negative bacteria and three fungi by using the tube dilution method. The oil was active against the tested gram-positive bacteria such as *Streptococcus faecalis, Staphylococcus aureus, Staphylococcus epidermidis, Micrococcus flavus, Micrococcus luteus* and *Bacillus subtilis*, gram-negative bacteria such as *Escherichia coli, Klebsiella pneumoniae, Proteus vulgaris, Proteus mirabilis, Pseudomonas aeruginosa, Enterobacter aerogenes, Salmonella typhimurium* and *Serratia marcescens* and Fungi such as *Aspergillus niger, Aspergillus fumigatus* and *Penicillium chrysogenum* [29] .

Kulkarni *et al.,* isolated stigmasterol , (+) sesamin , ursolic acid , corosolic acid, 3'-O-methyleupatorin and eupatorin from acetone extract of aerial parts of *Coleus mollis*. Among these, the compounds such as (+) sesamin, corosolic acid, and methyl eupatorin are being reported here first time from the genus. All the compounds were screened for their inhibitory action against *Mycobacterium tuberculosis,* and the compounds corosolic acid, 3'-O-methyleupatorin exhibited good anti-mycobacterial activity [30].

Ramu *et al.,* studied the *in-vitro* anticholinesterase potential of ethanol and water extracts prepared from the leaves of *Plectranthus mollis* using Ellman's colorimetric assay. The ethanol and water extracts of the leaf were prepared by the soxhlet extraction method. The results of the study indicated that both the ethanol and water extracts of the plant possess mild to moderate cholinesterase inhibitory activity [28].

***Coleus bishopianus* (Gamble):**
**Synonym:** *Plectranthus bishopianus* Gamble [5].

The plant is a rare and endangered plant found in the Western Ghats and evergreen forests of India, found growing on wet rocky surfaces mainly located at Chikmaglur region of Karnataka and Dindigul of Tamil Nadu [13]. The species is included in the possibly extinct category in the Red Data Book of Indian Plants [31]. The plant is erect under shrub, roots spreading at the nodes, basal stem cylindrical and younger stem quadrangular, semi-succulent. Leaves 3.5-7.5 × 2.2-5.5 cm, crenately dentate margin, slightly wavy, base rounded or slightly cuneate, nerves 5-6 pairs with obtuse apex, minutely puberulous, petiole up to 4 cm long, inflorescence thyrsoid panicle up to 20 cm long, oppositely paired racemose, panicles up to 5cm long, ovate bracts with acute apex and caudacous. Flowers large, distinct and purplish, pedicel pendant, calyx 2 lipped, tube decurved, throat obliquely swollen, upper lip short, 3-4 lobed, lower lip boat-shaped, base stipitate, puberulous, stamens 4, didynamous, declinate, slightly exserted, free filaments, anthers confluent, ovary 4-partite, slender style, tip bifid, nutlets ovoid or oblong and smooth [20].

Syamasundar isolated a new abietane diterpene, 6b-hydroxy-7a-methoxyroyleanone, along with two more diterpenoids 6,7-dehydroroyleanone and 6b, 7a-dihydroxyroyleanone a triterpene oleanolic acid and two sterols b-sistosterol and stigmasterol from the methanolic extract of the plant [32]. Vinodh *et al.*, isolated abietane diterpenoids 6, 7-dehydro-royleanone, 6β-hydroxy-7α-methoxyroyleanone and 6β, 7α-dihyroxyroyleanone from *Coleus bishopianus*. Pharmacological evaluation of the isolated compounds exhibited potent anti-bacterial, anti-oxidant, and anti-cancer (MTT assay, MCF-7 cell line) activities [33].

Smitha *et al.,* by morphological and micro morphological studies, proved that *C. bishopianus* and *C. deccanicus* are distinct species, and the later cannot be used as a synonym for *Coleus bishopianus* [34].

***Coleus fruticosus*:**
**Synonym:** *Plectranthus fruticosus* (Wight ex Benth.), *Plectranthus deccanicus* Briq [5].

**Common Name:** Forest spur-flower, Nettle geranium.

Branched herbs upto 22 cm tall, stem creeping at the base with many stiff, erect branches and very short internodes. Leaves in whorls, 4-8 per node 8 × 2 mm, narrowly linear, apex acute, puberulous. Flowers pink in colour, minute in dense terminal spikes up to 5 cm long; bracts c. 2 mm long, persistent. Calyx 2 mm long, campanulate, pubescent; lobes triangular, erect, or slightly inflexed. Corolla 1.5-2 mm long; tube c.1mm long;

lobes ovate-oblong, obtuse, hairy. Stamens 4, much exserted, bearded with purple hairs. Style flattened. Nutlets ellipsoid, smooth, yellowish-brown. The flowering and fruiting time is December to June. *Coleus fruticosus* is a popular garden plant and is often grown as ornamental [7]. The plant is endemic to Peninsular India, mainly seen in the Western Ghats, evergreen forests, and moist Localities. Often grown as live fences in the high ranges. In India, the plant is reported to form the states Kerala (Idukki-Kalvarimala) and Tamil Nadu (Coimbatore, Dindigul, Nilgiri) [21].

The plant is reported to have embryotoxic and fetotoxic activities on rodents. The plants are collected from the wild for local use as medicine. The plant is antimicrobial and is used to treat burns. The plant contains kaurane diterpenoids, which are partly responsible for the antimicrobial action [6]. The plant is also used as an insect repellant. Bunches of the plants are hung up indoors, or the stems are rubbed on window sills to repel flies [7].

***Coleus urticifolius* Benth.:**

**Synonym:** *Plectranthus urticifolius* (Benth.) *Plectranthus beddomei* Raizada [5]

**Common Name in India:** Padappanthalai.

*Plectranthus beddomei* is an evergreen perennial plant with a stem that becomes more or less woody. Erect shrubs. Leaves opposite, 5-9 × 4-8 cm, broadly ovate, acuminate apex, round to cordate base, glabrous on both sides, white warted on petioles and main nerves; venation prominent below; margins dentate. Inflorescence terminal panicles. Calyx 0.1-0.15 cm long. Corolla purple, broadly dilated at the throat, slender at the base, 2-lipped; upper lip ca 0.4 cm long, 4-lobed, lower 0.5-0.6 cm long, boat-shaped, entire [21]. The plant can be distinguished from other allied species by its woody winged stem, large cordate leaves, large and branched purplish paniculate inflorescence, and also tuberous roots [13].

The flowering and fruiting time is August to November. The plant is endemic to the southern Western Ghats at an altitude of 1300-1500. The general habitat is grasslands. In India, the plant is mainly distributed in the Idukki district of Kerala and Thirunelvelli of Tamil Nadu [21]. The plant is harvested from the wild for local use as a medicine. The plant is used to treat skin conditions [6]. Fresh leaves extract drunk for boils and blisters [35]. The plant is included in the IUCN red list of medicinal plants [38].

***Coleus paniculatus*:**

**Synonyms:** *Majana paniculata* (Benth.), *Solenostemon paniculatus* (Benth.), *Coleus glabratus* Benth. *Plectranthus glabratus* (Benth.), *Coleus wightii* Benth., *Plectranthus coleoides* Benth, *Plectranthus bernardii* [5].

**Common Name:** White-edged Swedish Ivy, Tropical Mint, Candlestick Vine, Ornamental *Coleus*.

**Loal Names:** Sirukizhangu, Koorkankizhangu

The plant is Fleshy pubescent perennial subshrubs. Leaves are aromatic and fleshy to 18 × 12 cm, ovate to elliptical, membranous, puberulus, acuminate apex with obtuse or slightly truncate base. The leaf margin is coarsely and prominently truncate, petiole to 10 cm. Inflorescence panicles of racemes, terminal to 25 cm long, racemes to 3.5 cm. Flowers pink to white. Fruiting calyx 2-lipped to 8 mm, upper lip entire, ovate, lower lip 4-toothed, teeth unequal, glabrous. Nutlets 4, oblong, 2 × 2 mm, brown, shining [21]. According to Smitha *et al.*, the plant is woody under shrubs with large fleshy leaves and can easily be distinguished from other species in having large purplish basally branched inflorescence. The posterior lip of the calyx is broad, which is always larger than anterior lips, straight and enlarged fruiting calyx tube [13].

The plant is mainly distributed in South India to South Indo-China [5] and Srilanka. The flowering and fruiting time is August to October. Found in the Shola forests of Peninsular India, Idukki and Wayanad districts of Kerala [21]. It is a woody undershrub with large fleshy leaves that can be easily distinguished from allied species in having large purplish basally branched inflorescence. The plant grows attached to wet rocky surfaces or in moist soils at an elevation of about 1,600 m [13].

Buchbauer *et al.*, analyzed the headspace and essential oil of the whole plant of *Plectranthus coleoides* by GC/FID, GC/FTIR/MS, and GC-sniffing techniques, and it was reported that the headspace was rich in monoterpenes, fenchone,

bornyl acetate, isobornyl acetate, and beta-caryophyllene. While the essential oil comprises additional odorous nitrogen compounds (especially amines) as well as minor aromatic (methylbenzene derivatives) components and a total of 41 constituents were identified [36].

***Coleus caninus* Roth.:**

**Synonyms:** *Plectranthus caninus* Roth, *Majana canina* Roth, *Ocimum monadelphum*, *Coleus heynei* Benth., *Coleus spicatus* Benth., *Majana spicata* (Benth.), *Coleus pachyphyllus* Gürke [5]

It is distributed mainly in Tropical Africa, India, and Burma. The plant is sometimes cultivated. Found mostly in scrub forest, rocky places, dry deciduous forests, plains, dry localities and is endemic to Peninsular India. Conservation status is nearly threatened [13].

The plant is a profusely branched herb clothed with soft hairs. Leaves 3 × 2.5 cm, obovate, crenate, pubescent below, fleshy; petiole to 1 cm. Spikes terminal, to 7 cm, tomentose, bracts 8 × 5 mm, ovate, mucronate, punctuate with red glands, deciduous; calyx pubescent outside, upper orbicular, ciliate, the lower 4 toothed, 2 mm; corolla tube 5 mm, lower lip 5 mm, blue; staminal tube 8 mm; style 1.5 cm, stigma bifid. The flowering and fruiting time is December to February [21].

The species can be easily distinguished by high aromaticity with a smell of camphor, its small obovate leaves, and spike-like inflorescence [13].

The phytochemical analysis carried out on the hydroalcoholic extract of *Coleus caninus* revealed the presence of flavonoids, glycosides, phenols, tannins, saponins, and alkaloids. The extract was also assayed for antimicrobial and *in-vitro* antioxidant activities. The plant extract showed antibacterial activity against *Bacillus subtilis*, *Escherichia coli*, *Proteus* species, *Serratia margarine*, and *Staphylococcus aureus* and exhibited good antioxidant activity [37].

**New Species from the Western Ghats:** So many new species also have been recognized recently from the Western Ghats, such as *Coleus gamblei*, which is a rare species endemic to the Western Ghats. The plant grows attached to wet rocky surfaces at an elevation of 2000 m [13]. Mathew *et al.*, recognized three new species as *Coleus petricola*, *Coleus idukkianus*, and *Coleus saxorum*. *Coleus anamudianus* is another one confined to Anamudi mountain, one of the highest mountains in the Western Ghats. The plant grows on wet rocky surfaces at an elevation of 1900 m [22].

**CONCLUSION:** *Coleus* is an important genus of Lamiaceae, comprised of aromatic herbaceous plants of perfumery, culinary, horticultural, medicinal, and food value with a worldwide distribution. This review is an attempt to collate together medicinally important *Coleus* species found in the evergreen forest *i.e.*, the Western Ghats, one of the biodiversity hot spots of India.

From the review, it is clear that the plants such as *Coleus malabaricus, Coleus mollis, Coleus urticifolius, Coleus bishopianus, Coleus parviflorus, Coleus caninus,* and *Coleus paniculatus* irrespective of the ethnobotanical importance are least exploited for the extraction and isolation of various phytoconstituents and need various phyto-pharmacological studies to prove the reported biological activities. It is expected that the present article would provide leads to further research on these potential medicinal plants.

This review also highlights the importance of conservation of aromatic and non-aromatic medicinal plants of the Western Ghats, especially highly potential threatened ones, by the application of contemporary biotechnological methods.

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