RECENT UPDATES ON THE GENUS COLEUS: A REVIEW

HIMESH SONI1 & AKHLESH KUMAR SINGHAI2

1Suresh Gyan Vihar University, Jaipur-302025, India, 2Lakshmi Narain College of Pharmacy, Bhopal, Madhya Pradesh-462021, India

Received: 17 October 2011, Revised and Accepted: 2 December 2011

ABSTRACT

Nature has been a source of medicinal agents for thousands of years and an impressive number of modern drug have been isolated from natural sources, many based on their use in traditional medicine. Plants from the genus *Coleus* have been used in traditional medicine by many cultures. Flavonoids, glycosides, phenolic compounds and volatile constituents have been reported as the major phytoconstituents of the *Coleus* species. This review describes the morphology, traditional and folklore uses, phytoconstituents and pharmacological reports of the prominent species of the genus *Coleus*. Various virgin areas of research on the species of this genus have been highlighted with a view to explore, isolate and identify the medicinally important phytoconstituents which could be utilized to alleviate various diseases affecting mankind.

Keywords: *Coleus*; Ethnopharmacology; Phytoconstituents; Pharmacological reports.

INTRODUCTION

Medicinal plants are of great significance to the health of individuals and communities. India is well known as the “Emporium of Medicinal Plants”. Due to their great importance, demand of medicinal plants has increased numerous folds. The genus *Coleus* was first described by De Loureiro (1790). The name *Coleus* is derived from the Greek word *Koleos*, which means sheath around the style. There are about 150 plants belonging to the mint herb family. Today, there are more than 500 varieties of coleus in cultivation all over the world. *Coleus* plants are very colorful and can be grown indoor as well as outdoors. Medicinal plants have curative properties due to the presence of various complex chemical substances of different chemical nature, which are found as secondary plant metabolites in one or more parts of these plants.

The focus of this review is to provide information on the universal morphology of *Coleus*. Plants from this genus known to contain various active principals of therapeutic value and possess biological activity against number of diseases. There are number of pharmacological effects reported on these plants.

GEOGRAPHICAL DISTRIBUTION

The Coleus group of plants grows in tropical to subtropical situations and in warm temperate climatic zone on mountains of India, Nepal, Burma, Sri Lanka, Thailand and Africa. It comes up well on the sun exposed dry hill slopes from 300m to 1800m altitude. A well drained medium fertile soil is suitable for its cultivation. It is propagated vegetatively through stem and root cuttings. Vine cuttings to a length of 10-15cm from the top portion are most ideal for planting. The land is ploughed or dug to a depth of 15-20cm and ridges are formed 30cm apart.

BOTANICAL IDENTIFICATION

*Coleus* is a member of the Lamiaceae family (mint), a perennial, branched, aromatic herb. The entire plant is aromatic. Members of the genus have square stems, branched and the nodes are often hairy. The pale blue corolla is bilabiate, the lower lobes are elongated and concave and it grows to a height of 30 cm to 60cm. The roots are thick, tuberous, fasiculated up to 20cm long, 0.5-2.5 cm thick, conical, fusiform, straight and strongly aromatic. Leaves appear when plant becomes pubescent and are narrowed into petioles. Flowers vary from a very slowly bluish to pale lavender. Racemes are perfect, the calyx is fine toothed and deflexed in the front. The plant possess four parted ovaries. The leaves and tuber have quite different odors.

MORPHOLOGY

The universal morphology of *Coleus* genus has been extensively reviewed. The genus *Coleus* of the family Lamiaceae (Labiatae) comprises a number of herbaceous medicinal plants which are particularly employed in home remedies for various ailments. Three species are most popular and commonly cultivated. They are *Coleus aromaticus*, *C. vertiveroides* and *C. forskohlii*.
long slender racemes. Fruits are orbicular or ovoid nutlets. The leaves are useful in cephalagia, otalgia, anorexia, dyspepsia, flatulence, colic, diarrhoea, cholera, halitosis, convulsions, epilepsy, cough, asthma, hiccup, bronchitis, strangury, hepatopathy and malarial fever\(^5\).

**Coleus vettiveroides**

Syn. Plectranthus vettiveroides

Sanskrit: Valakam, Hindi: Valak; Malayali: Irvelu, Tamil: Karavu, Telugu: Karuveru. It is seen in tropical countries and cultivated in gardens. It is a small profusely branched, succulent aromatic herb with quadrangular stems and branches and deep straw coloured aromatic roots. Leaves are glandular hairy, broadly ovate with dentate margins and prominent veins on the bark. Blue flowers are borne on terminal racemes. Fruits are nutlets. The whole plant is useful in hyperpiesia, vitiated conditions of pitta, burning sensation, strangury, leprosy, skin diseases, leukoderma, fever, vomiting, diarrhoea, ulcers and as hair tonic\(^6\).

**Coleus forskohlii**

Syn. C. barbatus Benth.

Hindi: Garmai, Gujarati: Mainul

The species name forskohlii was given to commemorate the Finnish botanist, Forskal. It is a perennial aromatic herb grown under tropical to temperate conditions for its carrot-like tubers which are used as condiments in the preparation of pickles. Plant height is approximately 1-2 feet and its striking leaves are teardrop shaped, shimmering green framing a bright purple centre; leaf color varies depending on the amount of shade. A cluster of stalked pale purple or blue flowers branches off a single stem. The rootstock is typically golden brown, thick, fibrous, and radially spreading. The roots are harvested in the fall, when forskolin is at its most concentrated and the color is the brightest\(^7\).

**ETHNO-PHARMACOLOGY**

The leaves are bitter, acid, thermogenic, aromatic, anodyne, appetizing, digestive, carminative, stomachic, anthelmintic, constipating, deodorant, expectorant, lithotriptic, diuretic and liver tonic. They are useful in cephalagia, otalgia, anorexia, dyspepsia, flatulence, colic, diarrhoea and cholera especially in children, halitosis, convulsions, epilepsy, cough, chronic asthma, hiccup, bocchitis, renal and vesical calculi, strangury, hepatopathy, malarial fever, antispasmodic and cathartic\(^10\). **Coleus forskohlii** has been used to treat hypertension, congestive heart failure, eczema, colic, respiratory disorders, painful urination, insomnia, and convulsions. Clinical studies of the plant and the forskolin constituent support respiratory disorders, painful urination, insomnia, and convulsions. It is also used as stimulant and carminative. Irvelu is most commonly used against ailments like vomiting, diarrhoea, leukoderma, fever, chronic liver diseases etc. It is used against indigestion and urinal disorders, and is a chief ingredient of many ayurvedic preparations like irvelu kashayam, devashagandha, snana choornam etc\(^12\).

**Table 1: Comparative anatomical characters of leaves of species.**

<table>
<thead>
<tr>
<th>Characters</th>
<th>Coleus aromaticus</th>
<th>Coleus vettiveroides</th>
<th>Coleus forskohlii</th>
</tr>
</thead>
<tbody>
<tr>
<td>Epidermal cell shape</td>
<td>Rectangular to polygonal</td>
<td>Polygonal</td>
<td>Polygonal</td>
</tr>
<tr>
<td>Stomatal type</td>
<td>Diacytic (caryophyllaceous)</td>
<td>Anomocytic</td>
<td>Anomocytic</td>
</tr>
<tr>
<td>Trichome type</td>
<td>Glandular trichomes</td>
<td>Stellate</td>
<td>Dorsiventral</td>
</tr>
<tr>
<td>Mesophyll</td>
<td>Dorsiventral</td>
<td>Hypoderm and secretory cells concave-convex</td>
<td>Biconvex</td>
</tr>
<tr>
<td>Midrib</td>
<td>Plano convex with flat adaxial side and hemispherical abaxial side(^8)</td>
<td>Rare raphides(^8)</td>
<td>Rare druses(^8)</td>
</tr>
<tr>
<td>Calcium oxalate crystals</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Table 2: Traditional uses of some Coleus species.**

<table>
<thead>
<tr>
<th>Species</th>
<th>Part used</th>
<th>Area</th>
<th>Uses</th>
</tr>
</thead>
<tbody>
<tr>
<td><em>C. barbatus</em></td>
<td>leaves</td>
<td>Africa, Brazil</td>
<td>stomachachalia</td>
</tr>
<tr>
<td><em>C. floribunda</em></td>
<td>root tuber</td>
<td>Nigeria, Indi a</td>
<td>as food, acute oedematous, acute oitis</td>
</tr>
<tr>
<td><em>C. amboinicus</em></td>
<td>seed</td>
<td>India</td>
<td></td>
</tr>
<tr>
<td><em>C. asirensis</em></td>
<td>whole leaf</td>
<td>Saudi Arabia</td>
<td>Antiseptic &amp; wound-dressing</td>
</tr>
<tr>
<td><em>C. vettiveroides</em></td>
<td>whole plant</td>
<td>India</td>
<td>vomiting and nausea</td>
</tr>
<tr>
<td><em>C. sylvestris</em></td>
<td>volatile oil</td>
<td>Australia</td>
<td>skin diseases</td>
</tr>
</tbody>
</table>

**PHYTOCHEMISTRY**

Flavonoids, glycosides, phenolic compounds and volatile constituents have been reported as the major phytoconstituents of the *Coleus* species. Literature survey has revealed that a number of reports are available on *Caromatus* and *C. forskohlii* while only sporadic reports are there on other species of *Cvetiveroides*. Various phytoconstituents have been presented in a tabular form.

**Table 3: Phytoconstituents of various Coleus species.**

<table>
<thead>
<tr>
<th>Species</th>
<th>Phytoconstituents</th>
</tr>
</thead>
<tbody>
<tr>
<td><em>Caromatus</em></td>
<td>Butylaniside, -caryophyllene, carvacrol, 1,8-cineole, p-cymene, ethylsalicylate,</td>
</tr>
<tr>
<td></td>
<td>eugenol, limonene, myrecene, and π-pinenes, -selenene, -terpinene, terpinen-4-ol,</td>
</tr>
<tr>
<td></td>
<td>thymol, verbenone (essential oil), apigenin, chrysoeriol, 5,4'-dihydroxy-6,7-dimethoxy-flavone (cisirsimaritin), eriodictyol, 6-methoxy-genkwanin, luteolin, quercetin, salvigenin, taxifolin, oxaloacetic acid, crategolic, euscaphe, 2,3-dihydro-olean-12-en-28-ol, pomocon, oleaneol, tomerentic, 2α,3α,19α,23α-tetrahydroxyurs-12-28-oic, ursoic acids, β-sitosterol-D-glucose isolated from leaves(^17).</td>
</tr>
<tr>
<td><em>C. forskohlii</em></td>
<td>Forsolin (7β-acetoxy-β-13-epoxy-1α, 6β, 9α-tetrahydroxy-labd-14-en-11-one), a diterpen compound is the active principle(^14) M in norriterpenoids, deacetylforskolin, 9-deoxy forskolin, 1, 9-deoxyforskolin, 1, 9-dideoxy-7-deacetylforskolin, and four other diterpenoids, have been reported to be present in the roots of <em>C. forskohlii</em> (^15).</td>
</tr>
<tr>
<td><em>Cvetiveroides</em></td>
<td>phenolic abietanoids (diterpenoids) Flavonoids seem to rare in Coleus. Only two flavonoids were identified, 4',7-dimethoxy-5,6-dihydroxyflavone and chrysoeriol in (^16).</td>
</tr>
</tbody>
</table>

Briskorn GH and Reidel W (1977) isolated eight triterpene acids from the leaves of the South American lamiaceae *Coleus amboinicus* Loureiro, 2,3-Dihydroxyolean-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 were found first time in lamiaceae\(^15\). Basak RK and Kumar P (1981) reported that the oil obtained by steam distillation (0.04-0.05%), has been found to contain terpinolene (3.75%), α-pinene (3.20%), β-pinene (2.50%), β-caryophyllene (4.20%), methyl eugenol (2.10%), thymol (41.3%), 1,8-cineole (5.45%), eugenol (4.40%), carvacrol (13.25%) and β- phellandrene (1.90%)\(^18\). Bos R and Hendrikss FH (1983) studied the composition of essential oil in the leaves of *Coleus aromaticus* Bentham and their importance.
as a component of species antiapoptosis. Thymol (79.6%) was shown to be the principal component of the oil. Pino et al., (1989) investigated the essential oil of Coleus amboinicus Lour. by means of LSC, GC, and GC-MS and 20 components were identified, including 13 terpene hydrocarbons and 7 oxygenated compounds. The oils contained about 64% carvacrol. Ammon and Kemper, 1992 and De Souza and Shah, 1988 were studied the tuberous root extracts of C. forskohlii contain minor diterpenoids viz., deactylforskolin, 9-deoxyforskolin, 1, 9-deoxyforskolin, 1, 9-dideoxy - 7-deacetyl forskolin in addition to forskolin (7β-acetoxy-8, 13-epoxy-16, 6β, 9α-trihydroxy-labd-14-en-11-one). Forskolin was discovered in the year 1974 and was initially referred to as coleonol. After the identification of other coleonols and diterpenoids the name was later changed to forskolin. Shah et al. (1980) reported that forskolin occurred exclusively in C. forskohlii and could not be detected in six other Coleus species viz., C. amboinicus, C. blumei, C. caninus, C. malabaricus, C. parviflorus and C. spicatus and six taxonomically related Plectranthus species viz., P. poesta, P. incausus, P. melissoides, P. mollis, P. rugosus and P. stocksii. Studies carried out using one hundred samples belonging to species of Coleus, Orthosiphon and Plectranthus of the sub family Ocimoideae at Japan also revealed the absence of forskolin in all the samples. Recently, two more new labdane diterpene glycosides, forskoliferpenoside A, B were also isolated from the ethanol extract of the whole plant.

Carvocrol
Thymol

Caryophyllene

Cavocrol
Forskolin

PHYTOPHARMACOLOGY

Irrespective of the presence of a large variety of phytoconstituents in the genus Coleus, only a few reports regarding the pharmacological investigations on the plants of this genus are available. Study was undertaken to check the efficiency of C. aromaticus extract in modifying cyclophosphamide and mitomycin-C induced clastogenicity in mouse bone marrow cells. It was calculated that Coleus extract micronucleus and lower dose of the extract are more effective than higher dose. Study was done to check antioxidant and free radical scavenging activity of an aqueous extract of C. aromaticus. An activity directed fractionation purification procedure was used to identify the DPPH free-radical scavenging components of C. aromaticus. Fresh leaves of C. aromaticus were extracted with water & then separated into hexane, ethyl acetate and water fractions. Three components showing strong DPPH radical scavenging activity were shown to be rosmarinic acid, Chlorogenic acid, and Caftaric acid. Caffeic acid was major constituent for free radical scavenging potential. Study was done to examine essential oil composition of Coleus amboinicus lour. The volatile constituents of the whole herb of Coleus amboinicus Lour. (Labiatae) were analyzed by GC-MS following isolation by hydrodistillation. Ten compounds were identified among which carvacrol (50.7 %), Camphor, caryophyllene (13.1 %) and patchouline (8.7 %) were dominant. Forskolin was used to examine essential oil composition of Coleus amboinicus lour. Forskolin, the volatile constituents of the whole herb of Coleus amboinicus lour. (Labiatae) were analyzed by GC-MS following isolation by hydrodistillation. Ten compounds were identified among which carvacrol (50.7 %), Camphor, caryophyllene (13.1 %) and patchouline (8.7 %) were dominant. Study was done to check antifungal activities of the essential oil of nine medicinal plant extract. In preliminary survey ethanolic extracts of nine medicinal plant parts such as C. aromaticus (leaves), Euphorbia tricali, C. longa, Aloe vera (aerial part) Zingiber officinale were tested for antifungal activity against Aspergillus flavus. Study was done to examine mast cell stabilization property of Coleus aromaticus leaf extract in rat peritoneal mast cells. Coleus aromaticus stabilizes mast cells in the rat mesenteric tissue. As most cells play a major role in Type I hypersensitivity - mediated diseases like allergic asthma and rhinitis, studies are under way to evaluate the efficacy of Coleus aromaticus due to its mast stabilization property in the human animal allergic models. Vera R et al., (1992) investigated essential oils of Plectranthus amboinicus by GLS & MS. Juice of its leaves is used for curing wounds and an infusion is said to possess anti-inflammatory properties. Baskar R et al., (1992) administered Coleus aromaticus leaf juice (at the rate of 1ml/rat/day) for 10-30 days in experimental urolithic rats. Reduction in the deposition of Ca and oxalate in the kidney tissues has been reported. Buzeneto MG and Perez- saad H (1999) reported antiepileptic effect of Plectranthus amboinicus (Lour) Spreng. Annaprurani S et al., (1999) exhibited significant antitumor and antimutagenic activities of Coleus aromaticus, Ocimum sanctum and Aegle marmelos and estimate polyphenol content in each. Santosha CM (2002) reported that Coleus amboinicus leaves exhibited increasing milk secretion of lactating animals and seemed to be superior to other treatment groups on milk secretion and also containing iron and potassium composition. Morallo RB et al., (1992) evaluated the biological activity of 18 medicinal plants along with Coleus amboinicus. Wasti et al. found that Coleus amboinicus did not exhibit pronounced insecticidal activity. Kathiresan RM (2000) reviewed the allelopathic potential of native plants for use as an alternative biocontrol tactic. Dried powder of the leaves of Omawali Coleus amboinicus L. at 40g/l as a water suspension killed water hyacinth with 24 h reducing the fresh weight by 80.72% and dry weight by 75.63% within one week. Gupta S et al., (2004) analysed nutrient and antioxidant contents of 13 locally available underutilized green leafy vegetables along with Coleus aromaticus leaf. Patil R et al., (2010) evaluated the diuretic properties of ethanolic and aqueous extracts of leaves of Plectranthus amboinicus in male albino rats. Palani S et al., (2010) investigated the nephroprotective, diuretic and antioxidant activities of the ethanolic extract of Plectranthus amboinicus at two dose 250 and 500 mg/kg bw on APAP-induced toxicity in rats. In a small study of seven patients with dilated cardiomyopathy, intravenous forskolin administered at 3 μg/kg/minute significantly reduced diastolic blood pressure (17%) without increasing myocardial oxygen consumption left ventricular function also improved. In a similar study (patient sample size not available), 4 μg/kg/minute of intravenous forskolin given to dilated cardiomyopathy patients, resulted in decreased vascular resistance and a 19-percent improvement in left ventricle contractility. Heart rate increased an average of 16 percent in study patients. Subjects also exhibited a 20-percent reduction in arterial pressure accompanied by symptomatic flush. Forskolin’s ability to inhibit platelet aggregation is of additional benefit in cardiovascular disease. Forskolin also demonstrates a direct effect on cerebrovascular vasodilatation via cAMP activation. In rabbits,
intravenous infusion of 10 μg/kg/min forskolin increased blood flow to the brain from 39 ± 5 to 56 ± 9 mL/min. This change was accompanied by a small decrease in mean arterial pressure, although cerebral oxygen consumption remained stable. These results indicate that forskolin may be useful in cases of cerebral vascular insufficiency and post-stroke. Asthma and other allergic conditions are characterized by decreased cAMP levels in bronchial smooth muscle, as well as high levels of PAF. In response to allergic stimuli, mast cells degranulate, histamine is released, and bronchial smooth muscle contracts. Forskolin activation of cAMP inhibits human basophil and mast cell degranulation, resulting in subsequent bronchodilation. Research has demonstrated aerosolized dry forskolin powder results in significant relaxation of bronchial muscles and relief of asthma symptoms. In one randomized, double-blind, placebo-controlled trial, 16 asthma patients were given a single inhaled (aerosolized) 10-mg dose of dry forskolin, an asthma medication (0.4 mg fenoterol), or placebo. Both fenoterol and forskolin administration resulted in significant, equivalent bronchodilation, but patients taking fenoterol experienced marked finger tremor response and a decrease in plasma potassium levels. These side effects were not observed in patients receiving forskolin. Ammon et al. reported an improvement in symptoms of psoriasis in four patients supplemented with forskolin. The ability of forskolin to regulate cAMP levels in skin cells has been shown to have therapeutic benefit for sufferers of psoriasis. Caprioli et al. demonstrated a significant decrease in IOP in rabbits, monkeys, and humans administered a topical forskolin suspension (1% forskolin). This effect was present at one hour post treatment of wound, burn, microbial infection, helminthic and liver disorder etc. The medicinal applications of these plants, countless possibilities for investigation, and a trend in relatively newer areas of its function. The present review of genus Coleus revealed that medicinal property of Coleus amboinicus is attributed to carvacrol, flavones, aromatic acids and tannins present in the plant. The essential oil from the plant contains carvacrol, ethyl salicylate, thymol, eugenol and chavicol. Leaves also contain cis- and trans- (E) ocimene and β-ocimene. Leaves are bitter, acrid, thermogenic, aromatic, anodyne, appetising, digestive, carminative, stomachic, anthelmintic, constipating, deodorant, expellent, diuretic and liver tonic. Coleus vettiveroides is bitter, cooling, diuretic, trigogenous and antipyretic. Coleus forskohlii roots are rich in diterpenoids like forskolin, coleonols, coleons, barbatustin, cyclobutatin, coleol, coleolone, deoxycoleon, 7-deacetylforskolin and 6-acetyl-7-deacetylforskolin. Its root is spasmylocic, CNS active, hypothermic and diuretic. Forskolin is bronchodilative and hypotensive. Forskolin is also useful in preventing the clotting of blood platelets, in reducing intraocular pressure in glaucoma and as an aid to nerve regeneration following trauma. Hence, phytochemicals and minerals of these plants will enable to exploit its therapeutic use. Therefore further studies may

TOXICITY STUDIES

Parra AL et al., (2001) determined the median lethal concentrations (LD50 value) of 20 plant extracts along with Plectranthus amboinicus using Artemia salina (tested at three concentrations: 10, 100 and 1000 mg/ml for each extract). Good correlation was found between in vivo and in vitro test (r = 0.85, P<0.05). Jose MA et al., (2005) have done the LD50 using OECD guideline for testing of chemicals revised draft guideline 423. The one tenth of the LD50 500mg/kg was chosen as a dose for further study. Sclareol isolated from C. forskohlii reported to be non-ctotoxic to resting human peripheral blood mononuclear leukocytes and have LD50 > 5mg/kg in rats. The study on forskolin also showed that it was extremely safe with an oral LD50 of 3100 mg/kg. The study on C. vettiveroides showed that it was extremely safe with an oral LD50 of >5000 μg/mL.

CONCLUSION

The therapeutic efficacy of the genus Coleus extensively used in Indian System of Medicine has been established through modern testing and evaluation (pre-clinical and clinical trials) in different disease conditions. These studies place this indigenous drug a novel candidate for bioprospection and drug development for the

Fig 4: Mechanism of Action of Forskolin

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be carried out to prove the potential of these plants. This genus Coleus are easy available in our country and leaves of the plant possess a wide range of biological properties. In future study, the isolated principles of extracts of different species of Coleus needs to be evaluated in scientific manner. It could be concluded that genus Coleus are rich source of compounds, interesting chemical structures and various biological active products.

ACKNOWLEDGEMENTS

Author acknowledge to the Dr.A.K. Singhai, Principal L.N.C.P. Bhopal (M.P.) support to carry-out research work on Coleus species.

REFERENCE

52. Parra AL, Yhebra RS, Sardinas IG and Buela LI. Comparative study of the assay of Artemia salina L. and the estimate of the medium lethal dose (LD50 value) in mice, to determine oral acute toxicity of plant extracts. Phytomedicine 2001; 8(S): 395-400.