

# INTERNATIONAL JOURNAL OF APPLIED BIOLOGY AND PHARMACEUTICAL TECHNOLOGY

## www.ijabpt.com Volume-3, Issue-4, Oct-Dec-2012 Coden : IJABPT Copyrights@2012 ISSN : 0976-4550

Received: 25<sup>th</sup> Sept-2011

Revised: 11<sup>th</sup> Oct-2012

Accepted: 12<sup>th</sup> Oct-2012 Review article

#### PATHORCHUR (COLEUS AROMATICUS): A REVIEW OF THE MEDICINAL EVIDENCE FOR ITS PHYTOCHEMISTRY AND PHARMACOLOGY PROPERTIES

Om Prakash Rout<sup>1</sup>, Rabinarayan Acharya<sup>2</sup>, Sagar Kumar Mishra<sup>3</sup>, Rashmibala Sahoo<sup>4</sup>

<sup>1</sup>Dept. of Dravyaguna, Govt. Ayurved College, G.E. Road, Raipur Chhattisgarh. <sup>2</sup>Dept. of Dravyaguna, I.P.G.T & R.A., Gujarat Ayurved University, Jamnagar, Gujrat, India. <sup>3</sup>Pharmacognosy & Phytochemistry Division, University Dept. of Pharmaceutical Sciences, Utkal University, Vani Vihar, Bhubaneswar, Odisha, India.

<sup>4</sup>State Drug Testing Laboratory (ISM), Ayurvedic Hospital Campus, BJB Nagar, Bhubaneswar, Odisha, India

**ABSTRACT:** *Coleus aromaticus* Benth., (Fam. Lamiaceae), syn. *Coleus amboinicus* Lour. Spreng or *Plectranthus ambonicus* Lour, is commonly known as Indian/ country borage and 'Pathorchur' in Hindi and Bengali. It is recorded in the Indian system of medicine as one of the sources of Pashanabheda. It is large succulent aromatic perennial herb, shrubby below, hispidly villous or tomentose. It is found throughout India, Ceylon and Moluccas. The leaves of the plant are bitter, acrid and were being widely used traditionally for various purposes. The plant has been worked out very well and isolated several chemical constituents and had shown various biological properties. This review is an effort to compile all the information reported on its macroscopic, microscopic features, nutritional content, phytochemistry, pharmacology and therapeutic uses.

Keywords: Pathorchur, Coleus aromaticus, phytochemistry, pharmacology, therapeutic uses.

## INTRODUCTION

Coleus is a name which derives from an earlier classification under the genus name Coleus, species of which are currently included in either Solenostemon or another genus, Plectranthus. The word Coleus come from the Greek "koleus', meaning sheath. It is believed that there are 150 species of Coleus .It is a genus of perennial plants, native to tropical Africa, Asia, Australia, the East Indies, the Malay Archipelago, and the Philippines. Many cultivators of the Southeast Asian species Coleus have been selected for their colorful variegated leaves, usually with sharp contrast between the colors where the leaves are green, pink, yellow, maroon, and red (Uphof et al., 1959). Coleus aromaticus Benth. (Fam. Lamiaceae), syn. Coleus amboinicus Lour. Spreng or Plectranthus ambonicus Lour, is commonly known as Indian/ country borage and 'Pathorchur' in Hindi and Bengali (Kumar et al., 2007). It is recorded in the Indian system of medicine as one of the sources of Pashanabheda (Chopra et al., 1956). The leaves of the green type of country borage are often eaten raw with bread and butter. The chopped leaves are also used as substitute for sage (Salvia officinalis L) in stuffing. Coleus aromaticus is used for seasoning meat dishes and in food products, while a decoction of its leaves is administered in cases of chronic cough and asthma (Anonymous, 1992). It is considered to be an antispasmodic, stimulant and stomachic and is used for the treatment of headache, fever, epilepsy and dyspepsia. It is used to treat conditions such as indigestion, diarrhea, nervous tension, insect bites, toothache, earache, rheumatism, whooping cough, and bronchitis (Warrier et al., 1995). The plant also finds prominent importance in modern medicine (Faleiro, Leonor et al., 2005 & Dragland, Steinar et al., 2003).

## SCIENTIFIC CLASSIFICATION

Kingdom:	Plantae
Unranked:	Angiosperms
Unranked:	Eudicots
Unranked:	Asterides
Order:	Lamiales
Family:	Lamiaceae
Genus:	Plectranthus
Species:	P. amboinicus
Binomial name:	Plectranthus amboinicus (Lour.) Spreng
Synonyms:	Coleus amboinicus Lour.
	Coleus aromaticus Benth.

VERNACULAR NAMES (Chopra et al., 1956, Kirtikar et al., 1935 & Sharma et al., 1995)

Sanskrit:	Parnayavani
Bengal:	Paatharchur, Paterchur
English:	Country borage, Indian Borage.
Gujarati:	Ovvapaan
Hinidi:	Pattaajvaayana
Kanada:	Karpurahalli, Penova
Malalayama:	Kannikurkka, panikkurukka, navarayilla
Oriya:	Hemakedar, Amarpoi
Punjabi:	Patharachur
Tamil:	Karpuravalli
Telagu:	Kapparillaku, Vamu-aku.
DISTRIBUTION	~~

This grassy plant is found or cultivated throughout India, Ceylon and Moluccas (Nadkarni *et al.*, 2002). Wild in Rajputana, also cultivated in gardens (Kirtikar *et al.*, 1935).

#### MACROSCOPIC FEATURES

It is a large succulent aromatic perennial herb with hispidly villous or tomentose fleshy stem. Leaves are simple, opposite, broadly ovate, crenate and fleshy. Flowers are pale purplish in dense whorls at distant intervals in a long slender raceme. Fruits are orbicular or ovoid nutlets (Warrier *et al.*, 1995).

#### MICROSCOPIC CHARACTERS

**Petiole** – Diagrammatic cross section of petiole is slightly concave outline on the adaxial side and concave on the abaxial side. Trichomes of glandular and non-glandular types are noticed. The petiolar epidermis, a single layer of laterally elongated cells is followed by a continuous 2-3 layered collenchyma. The vasculature comprises of a ring of eight collateral vascular bundles, of which the two lateral abaxial bundles are larger in size. In addition, there are two small vascular strands, one at each corner of the adaxial side. The ground tissue consists of thin walled parenchymatous cells (Om *et al.*, 2010)..

**Midrib** - Transverse section of leaf passing through the midrib show a hemispherical protrusion on the abaxial side and has as light depression on the adaxial side. 2-3 layers of lacunar collenchyma is situated just above the abaxial epidermis. Below the adaxial epidermis occurs the palisade layer which is continuous over the midrib also. The ground tissue consists of parenchymatous cells. A solitary vascular bundle runs along the midrib (Om *et al.*, 2010).

### Coden : IJABPT Copyrights@2012 ISSN : 0976-4550

**Lamina-** Lamina is dorsiventral in structure. The adaxial and abaxial epidermis composed of rectangular cells. The abaxial cells is being distinctly smaller. The stomatas are diacytic with one smaller and one larger subsidiary cells. The stomata lie flush with the epidermal surface. Subjacent to the adaxial epidermis three layers of slightly vertically elongated, columnar, closely arranged palisade cells are seen. Under this palisade 4 to 5 layered spongy tissue is composed of nearly rounded closely arranged. The upper and lower epidermal surfaces of the lamina have dense trichomes. The trichomes are of the uniseriate glandular and non glandular types. The uniseriate non glandular trichomes are 3-6 celled, curved and progressively tapering. The glandular are provided with two celled stalk, of which the lower cell is the longest and the second that subtends the globular unicellular head nearly discoid (Om *et al.*, 2010).

#### **Powder characteristics**

The leaf powder was studied under different magnifications, which shows diacytic stomata, epidermal cell in surface view with slightly wavy walls, glandular and uniseriate trichomes (Om *et al.*, 2010).

## NUTRITIONAL CONTENT

*Coleus aromaticus* is an edible, nutritive plant, which contains proteins (0.6%), vitamins (0.003% ascorbic acid, 0.00008% thiamine), minerals (0.158% calcium, 0.016% phosphorus, 0.138% potassium, 0.0047% sodium, 0.088% magnesium), trace metals (0.262% iron, 0.0003% zinc, 0.00012% copper, 0.000022% chromium), soluble dietary fibers (0.31%), insoluble dietary fibers (1.56%), phytic acid (0.00092%), soluble oxalate (0.02%). Thus, *Coleus aromaticus* is a good source of nutritious compounds and can be used as a food supplement. This plant has chlorophyll a 0.44  $\pm$  0.13 and chlorophyll b 0.29  $\pm$  0.10. It also contains total xanthophylls (0.356mg/g of dry weight of plant); neoxanthin, leutin, zeaxanthinics,  $\alpha$ - carotene (0.157mg/g of dry weight) and  $\beta$ - carotene (0.0035mg/g of dry weight) (Sahaykhare *et al.*, 2001).

## CHEMICAL CONSTITUENTS

Butylaniside, -caryophyllene, carvacrol, 1-8-cineole, p-cymene, ethylsalicylate, eugenol, limonene, myrcene, and pinenes, -selenene, -terpinene, terpinen-4-ol, thymol, verbenone (essential oil), apigenin, chrysoeriol, 5,4-dihydroxy-6,7-dimethoxy-flavone (cirsimaritin), eriodictyol, 6-methoxygenkawanin, luteolin, guercetin, salvigenin, taxifolin, oxaloacetic acid, crategolic, euscaphic, 2 -3 -dihydro-olean-12-en-28-oic, pomolic, oleanolic, tormentic, 2 ,3 ,19 ,23tetrahydroxyurs-12-en-28-oic, -sitosterol- -D-glucoside isolated from the leaves (Chatterjee et al., 2001). Leaves of Coleus aromaticus contain flavones salvigenin, 6-methoxygenkwanin, quercetin, chrysoeriol, luteolin and apigenin, the flavanone eriodyctol and the flavanol taxifolin, triterpenic acids; oleanolic acid, 2,3-dihydroxyoleanolic acid, crategolic acid, ursolic acid, pomolic acid, euscaphic acid, tormentic acid and 2,3,19,23-tetrahydroxyursolic acid (Sahaykhare et al., 2011). On the other hand, volatile constituent of Mauritius's Coleus aromaticus contains camphor (39%) along with carvacrol (41.3%) (Gurib et al., 1996). Other constituents reported are (Z)-1, 3-hexadiene (0.1%), (Z)-3-hexenol (0.6%), (E,Z) farnesene (0.2%), (E,E) farnesene (0.2%), (E,E) farnesene (0.2%) and muurolene(0.2%) (Prudent et al., 1995). GC/MS of Coleus aromaticus in Pakistan shows the thymol as a major constituent instead of carvacrol along with p-cymene, terpinen-4-ol, caryophyllene, verbenone, tert-Bu anisole, oxygenated sesquiterpene (Hague et al., 1988), but according to Malik et al. carvacrol is a major component (40.42%) of C. aromaticus volatiles in Pakistan; with other compounds limonene, eugenol, thymol, ethyl salicylate, terpinene, selinene, p-cymene, pinene, caryophyllene and myrcene (Malik et al., 1985). The presence of patchoulane: 8.7% along with carvacrol: 50.7% and caryophyllene: 13.1% was reported by Mangathavaru et al., (2005). Carvacrol has isolated from oils of Coleus aromaticus and identified by its urethan and NO derivatives (Weehuizen et al., 1918).

## PHARMACOGNOSY

Brindha *et al.*, (1991) presented the pharmacognostic, exomorphology, histomorphology and physico-chemical evaluation of the leaf and stem of *Coleus aromaticus*. Kaliappan ND and Viswanathan PK *et al.*, (2008) carried out the micro morphological studies on the leaves of *Plectranthus amboinicus*. Nirmala *et al.*, (2008) carried out micro morphological studies on the leaves of *Plectranthus amboinicus* one of the WHO accepted parameter for identification of medicinal plants.

## PHYTOCHEMISTRY

Essential oil of Coleus aromaticus, grown in India, is rich in carvacrol, thymol, eugenol, chavicol, ethyl salicylate (Dutta et al., 1959). Chloroform fraction of this plant shows the presence of three flavones; Salvigenin, Cristimartin and Chrvsoeriol (Ragasa et al., 1999). Knab et al., (2009) have reported presence of eucalyptol in Coleus aromaticus leaves when extracted through steam distillation and solid phase micro extraction (SPME) methods. Brieskorn et al., (1977) isolated eight triterpenic acids from the leaves of the South - American lamiaceae Coleus amboinicus Loureiro. 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 and 2.3.19.25-oic acid and 2.3.19.25-oic acid and 2.3.19.25-oic acid and 2.3.19.25-oic acid and 2.3.19 oic acid were found first time in lamiaceae. Baslas et al., (1981) reported that the oil obtained by steam distillation (0.04-0.05%), has been found to contain terpinolene (3.75%), -pinene (3.20%), -pinene (2.50%), - caryophyllene (4.20%), methyl eugenol (2.10%), thymol (41.3%), 1.8-cineole (5.45%), eugenol (4.40%), carvacrol (13.25%) and phellandrene (1.90%). Methanolic extract of leaves of Coleus aromaticus contains chlorogenic acid, caffeic acid, coumaric acid polyphenolic compounds with strong antioxidant property (Rasineni et al., 2008). Bos et al.,(1983) studied the composition of essential oil in the leaves of Coleus aromaticus Benthum and their importance as a component of species antiapthosae. Malik et al., (1985) studied on essential oil of the Coleus aromaticus plant. Haque IU (1988) detected fifteen components in the essential oil (0.1%) obtained from dry steam distillation of the fresh stalk and leaves of Coleus aromaticus. Thymol (79.6%) was shown to be the principal component of the oil. Kumaran et al.,(2007) used an activity directed fractionation and purification process to identify the DPPH (1,1-diphenyl-2picrylhydrazyl) free radical scavenging components of Coleus aromaticus Benth. Rosmarinic acid was found as a major component and principally responsible for the radical scavenging activity of *Coleus aromaticus*. Ragasa *et al.*, (1999) reported that the air dried leaves of *Coleus amboinicus* afforded three flavones; salvigenin, crisimaritin and chrysoeriol by silica gel chromatography. There structures were elucidated by extensive 1D and 2D NMR and UV spectroscopy. Antimicrobial assay on salvigenin and crisimaritin showed low activities against the microorganisms tested. Pino et al., (1996) isolated volatile compounds from Coleus aromaticus leaf by steam distillation, hexane extraction and super critical CO<sub>2</sub> extraction and identified 26 components by GC/MS. Pino et al., (1989) investigated the essential oil of Coleus amboinicus Lour. by means of LSC, GLC and GC-MS and 20 components were identified, including 13 terpene hydrocarbons and 7 oxygenated compounds. The oils contained about 64% carvacrol. Singh et al., (2002) investigated the leaf essential oil of *Coleus aromaticus* by GC and GC-MS techniques which indicated the presence of six components, accounting for 97 percent of the total oil. Mallavarapu et al., (1999) analyzed the essential oils of Coleus aromaticus distilled in different seasons by capillary GC and GC/MS. The oils were found to contain carvacrol, pcymene and gamma-terpinene as major constituents. The oil produced in September was found to contain higher contents of carvacrol and beta-caryophyllene and oxygenated constituents than the oil produced in May.

## PHARMACOLOGY

It has been reported to exhibit antioxidant (Salman et al. 1996), leishmania (Perumal et al. 2004), urolithiasis (Baskar et al., 1992 & Jose et al., 2005), antiepileptic (Buznego et al., 1999), antitumor and antimutagenic (Annapurani et al., 1999), neuropharmacoligical (Pirez et al., 2003), radioprotective effect (Rao et al., 2006), antimicrobial (Rao et al., 1991 & Deena et al., 2002), antibacterial, antifungal properties (Prudent et al., 1995 & Perumal et al., 2004). Certain active principles of this plant are being effective in relieving the intraocular pressure of glaucoma, lowering blood pressure in patients with heart disease, also found to stabilize the cells that release histamine and other inflammatory compounds (Andre et al., 1995). Gurgel et al., (2009) have shown that hydroalcohic extract on dosing to mice at rate of 100, 150, 250 and 350 mg/kg suppressed the growth of sarcoma-180 and Ehrlich ascite carcinoma tumors. Vera 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-influenza properties. Ethanolic extract of *Coleus aromaticus* is reported to have anticlastogenic potency against anticancer drugs (Prasad et al., 2002), diuretic properties, nephroprotective activities (Palani et al., 2010 & Patel et al., 2010). Aqueous extract of fresh leaves of C. aromaticus and tissue cultureraised plants posses a dose-dependent positive inotropic effect on isolated frog heart (Hole et al., 2009). C. aromaticus, causes reduction in egg laying capacity, retard in adult emergence and weight loss in the pulse beetle Callosobruchus maculates (Babu et al., 1999). C. aromaticus offers to have biologically controlactivity for water hyacinth. It is reported that 40g/l as a highest dosage and 20g/l as a medium dosages cause complete killing of water hyacinth within 24 hours where as 10g/l offers completekilling of water hyacinth in 9 days (Kathiresan et al., 2000).

International Journal of Applied Biology and Pharmaceutical Technology Page: 351 Available online at www.ijabpt.com

#### Coden : IJABPT Copyrights@2012 ISSN : 0976-4550

Gurgel et al., (2009) evaluated the anti-inflammatory and antitumor activities of the hydroalcoholic extract from leaves of Plectranthus amboinicus (Lour.) Spreng. Chang et al., (2007) investigated therapeutic efficacy of Plectranthus amboinicus in treating rheumatoid arthritis using collagen-induced arthritis in animal model. Baskar et al., (1992) administered *Coleus aromaticus* leaf juice (at the rate of 1ml/rat/day) for 10-30 days in experimental urolithiatic rats. Reduction in the deposition of Ca and oxalate in the kidney tissue has been reported. Hole et al., (2008) studied that aqueous extracts of fresh leaves of Coleus amboinicus Lour, parent, as well as tissue culture-raised plants showed a dose dependent positive inotropic effect on isolated frog heart. Perivanayagam et al., (2008) has performed in vivo study of aqueous extract of leaves of Plectranthus amboinicus on Plasmodium berghei yoelii. Rao et al., (2006) elucidated in vitro free radical scavenging potential and inhibition of lipid peroxidation by Coleus aromaticus hydrochloric extract (CAE). Anti-clastogenic and radioprotective potential of CAE were studied using micronucleus assay after irradiating Chinese hamster fibroblast (V79) cells. Buzenego et al., (1999) reported antiepileptic effect of Plectranthus amboinicus (Lour) Spreng. Shyama et al., (2002) investigated the anticlastogenic potency of the ethanolic extract of *Coleus aromaticus* and the results indicate the protective effect against cyclophosphamide and mitomycin-c induced cytogenetic damage. Kumar et al., (2007) studied mast cell stabilization property of aqueous and hydrochloric leaf extract of Coleus aromaticus in rat peritoneal mast cells. Santosa (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. Annapurani et al., (1999) exhibited significant antitumour and antimutagenic activities of Coleus aromaticus, Ocimum sanctum and Aegle marmelos and estimated polyphenol content in each. Singh et al. 2002 have reported insecticidal activity of oils at a dose of 2.5× 10-2 mg/cm3. Polysachharides extracted from dried plant parts of Coleus aromaticus shows anticoagulant activity. Perez et al., (2003) reported neuropharmacological profile of *Plectranthus amboinicus* (Lour) Spreng. Kumaran et al., (2006) investigated the antioxidant potency of freeze dried aqueous extract of Coleus aromaticus, employing various established in vitro models. Jose *et al.*, (2005) have done the  $LD_{50}$  using OECD guideline for testing of chemicals revised draft guideline. The one tenth of the LD<sub>50</sub> 500mg/kg was chosen as a dose for the further study. The urine and histopathological results clearly revealed the antilithiotic activity of Plectranthus amboinicus particularly of calcium oxalate origin.

## TOXICITY STUDIES

Parra *et al.*, (2001) determined the median lethal concentrations (LD<sub>50</sub> value) of 20 plant extracts along with *Plectranthus amboinicus* using *Artemia salina* (tested at three concentrations: 10, 100 and 1000 g/ml for each extract). Good correlation was found between in vivo and in vitro test (r = 0.85, *P*<0.05).

## THERAPEUTIC USES:

It is used against various disorders in indigenous system of medicine, such as severe bronchitis, asthma, diarrhoea, epilepsy, renal and vesicle calculi, fever (Warrier *et al.*, 1995), common cold, cough, headache, indigestion, urinary diseases, vaginal discharges (Shamachar *et al.*, 1967), colic, dyspepsia, , convulsions (Kirtikar *et al.*, 1935), stimulates the functions of liver, indicated in kidney and bladder stones, dysentery, cholera, bilious affections, poisonous bites (Kirtikar *et al.*, 1935 & Sivarajan *et al.*, 1994) and vitiated conditions of *Kapha* and *Vata* (Sharma *et al.*, 1995). Leaves are anthilithic, antispasmodic, carminative, cathartic, stimulant, stomachic. They are useful in urinary diseases, vaginal discharge. The leaves juice carminative when mixed with sugar, given to children in colic. It is beneficial in asthma, calculus, chronic cough, dyspepsia, fever, gonorrhea, piles and in strangury. It is externally used in conjunctivitis and bruised leaves locally applied in headache. The expressed juice is used in epilepsy and other convulsive disorders and plant extracts used in the treatment of gastrointestinal troubles (Chatterjee *et al.*, 2001).

## CONCLUSIONS

The detailed information in this review shows its potential therapeutic values and is a rich source of biologically active compounds. Considering the easy availability of *Coleus ambionicus* in our country, it seems that still there is a scope for scientific studies to fully exploit its medicinal properties to support traditional claims as well as, exploring some new and promising leads. It will provide a pathway for future study.

#### REFERENCES

- A. Babu, N. Raja, S. Albert, S. Ignacimuthu and S. Dorn (1999). Comparative efficacy of some indigenous plant extracts against the pulse beetle *Callosobruchus maculatus* F. (Coleoptera: Bruchidae), Biological Agriculture and Horticulture 17: 145–150.
- A. Chatterjee, S.C. Pakrashi (1997). The Treatise on Indian Medicinal Plants. National Institute of Science Communication, New Delhi, Vol. 5, 8-13.
- A. Gurib-Fakim, M.D. Sweraj, J. Gueho and E. Dulloo (1996). Medicinal plants of Rodrigues, Inter. J. of Pharmacognosy, 341: 2–14.
- A. Knab, McKinney, E. Heather, Maurer and K. Marta (2009). Isolation of the compounds in Mentha piperita, Mentha spicata and Coleus amboinicus, Abstracts of Papers, 238th ACS National Meeting, Washington, DC, United States, 16-20.
- A. Kumar, K. Elango, S. Markanday, C.V. Undhad, A.V. Kotadiya, B.M. Savaliya, D.N. Vyas, D. Datta (2007). Mast cell stabilization property of Coleus aromaticus leaf extract in rat peritoneal mast cells. Indian Journal of Pharmacology, Vol 39 (2), 117-118.
- A. Kumaran and R. J. Karunakaran (2006). Antioxidant and free radical scavenging activity of an aqueous extract of Coleus aromaticus. Food Chemistry. 97: 109-14.
- A. Kumaran and R. J. Karunakaran (2007). Activity guided isolation and identification of free radical scavenging components from an aqueous extract of Coleus aromaticus. Food Chemistry. 100: 356-61.
- A. Rao, GSJG, P. Baby, R.Y Prasad (1991). In vitro Leaf oil of Coleus amboinicus Lour: the anti-microbial studies. Perfume Kosmetik, 72:744-45.
- A.K. Nadkarni (2002). Indian Materia Medica. Popular Prakashan, Bombay, India; Vol I, 371-72.
- A.L. Parra, R.S. Yhebra, I.G. Sardinas and L.I. Buela (2001). 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. 8(5): 395-400.
- A.P. Gurgel, J.G. da Silva, A.R.S. Grangeiroa, D.C. Oliveira, C.M.P. Limaa, A.C.P. da Silvaa, R.A.G. Oliveira and I.A. Souzac (2009). In vivostudy of the anti-inflammatory and antitumor activities of leaves from Plectranthus amboinicus (Lour.) Spreng (Lamiaceae), J. of Ethnopharmacol, 125: 361–363.
- Anonymous (1992), The Useful Plants of India. Council of Scientific and Industrial Research, New Delhi.
- B.R. Shamachar (1967). Use of Pashanabheda Coleus aromaticus in ashmari (Urinary calculi). Natn. Med. J., 9, 475-477.
- B.S. Rao, R. Shanbhoge, D. Upadhya, G.C. Jagetia, S.K. Adiga, P. Kumar P (2006). Antioxidant, anticlastogenic and radioprotective effect of Coleus aromaticus on Chinese hamster fibroblast cells (V79) exposed to gamma radiation. Mutagenesis, 21:237-42.
- C.H. Brieskorn and W. Riedel (1977). Triterpenic acids from Coleus amboinicus Loureiro. Arch Pharm (Weinheim). 310(11): 910-16.
- C.M. Santosa (2002). The effect of 'bangunbangun' leaves (Coleus amboinicus L.) consumption of the potency of milk secretion and its composition of lactating mothers. Indonesian Journal of Pharmacy. 13(3): 133-39.
- C.Y. Ragasa, V. Sangalang, Z. Pendon and J.A. Rideout (1999). Antimicrobial flavones from Coleus amboinicus Philippine J. of Sci. 128: 347-351.42
- D. Prudent, F. Perineau, J.M. Bessiere, G.M. Michel, J.C. Baccou (1995). Analysis of the essential oil of wild oregano from Martinique (Coleus aromaticus Benth.), evaluation of its bacteriostatic and fungistatic properties. J Esst Oil Res, 7:165-73.
- Dragland, Steinar; et al.(2003). Several culinary and medicinal herbs are important sources of dietary antioxidants. J Nutr. 133 (5): 1286–1290.
- F. França, E.L. Lago & P.D. Marsden (1996). Rev. Soc. Brasil. Med. Trop. 29: 229-232.
- F. Weehuizen and Weltevreden (1918). The phenol from the leaves of Coleus amboinicus Lour. Recueil des Travaux Chimiques des Pays-Bas et de la Belgique, 37: 355-356.

#### Coden : IJABPT Copyrights@2012 ISSN : 0976-4550

- G. Perumal, C. Subramanyam, D. Natrajan, K. Srinivasan, C. Mohanasundari, K. Prabakar (2004). Antifungal activities of traditional medicinal plant extracts: A preliminary survey. J Phytolog Res, 17:81-83.
- G. Singh, O.P. Singh, Y.R. Prasad, M.P. de Lampasona and C. Catalan C (2002). Studies on essential oils, Part 33: chemical and insecticidal investigations on leaf oil of Coleus amboinicus Lour. Flavour and Fragrance Journal. 17: 440-42.
- G.K. Rasineni, D. Siddavattam, A. R. Reddy (2008). Free radical quenching activity and polyphenols in three species of Coleus, J. of Medicinal Plants Research 2(10): 285-291.
- G.R. Mallavarapu, L. Rao and S. Ramesh (1999). Essential oil of Coleus aromaticus Benth, from India. J. Esst. Oil Research. 11: 742-44.
- H. Purez Saad, M.T. Buznego, M. Llanio Villate, M. Fernαndez Perez, R. Menundez (2003). Neuropharmacological profile of Plectranthus amboinicus (Lour.) Spreng. (Indian borage). Rev Neurol, 36:98-9.
- Haque I.U. (1988). Analysis of volatile constituents of Coleus aromaticus. Journal of the Chem. Society of Pakistan. 10(3): 369-71.
- J. C. Th. Uphof (1959). Dictionary of Economic Plants 191. Codicote: Wheldon and Whesley. 1
- J. Pino, A. Rosado and P. Borges (1989). Volatile components in the essential oil of wild oregano (Coleus amboinicus Lour.). Food / Nahrung. 34(9): 819-23.
- J.A. Pino, J. Garcia and M.A. Martinez (1996). Comparative chemical composition of the volatiles of Coleus aromaticus produced by steam distillation, solvent extraction and supercritical carbon dioxide extraction. Journal of Essential Oil Research. 8(4): 373-75.
- J.G.D. Sálman, T.E.G. Jimenez & R.M. Castilho (1996), Rev. Cub. Plant. Med. 2: 27-30.
- J.M. Chang, C.M. Cheng, L.M. Hung, Y.S. Chung and R.Y. Wu (2007). Potential use of Plectranthus amboinicus in the treatment of rheumatoid arthritis. Evid Based Complement Alternative Medicine.
- K. Mangathayaru, D.V.V. Pratap, D. Thirumurgan, P.S. Patel, D.J. David and J. Karthikeyan (2005). Essential oil composition of Coleus amboinicus Lour. Indian J. of Pharmaceutical Sci., 67(1): 122-123.
- K. Periyanayagam, K. Nirmala Devi, L. Suseela, A. Uma and M. Ismail (2008). In vivo antimalarial activity of leaves of Plectranthus amboinicus (lour) spreng on Plasmodium berghei yeolii. J Commun Dis. 40(2): 121-25.
- K.R. Kirtikar, B.D. Basu (1935). Indian Medicinal Plants, Lalit Mohan Basu, Allahabad; India, Vol. III, 1970-1971.
- L. Faleiro, M. Graca, S. Gomes, L. Costa, F. venancio, A. Teixeira, A. Figueiredo, J. barroso and L. Pedro (2005). Antibacterial and Antioxidant Activities of Essential Oils Isolated from Thymbra capitata L. (Cav.) and Origanum vulgare L. J. Agric. Food Chem. 53 (21): 8162–8168.
- M. A. Jose, Ibrahim, S. Janardhanan (2005). Modulatory effect of Plectranthus amboinicus Lour. on ethylene glycol induced nephrolithiasis in rats. Indian J Pharmacol, 37:43-4.
- M.J. Deena, K. Sreeranjini, J.E. Thoppil (2002). Antimicrobial screening of essential oils of Coleus aromaticus and Coleus zeyla. Indian J Aromather , 12:105-7.
- M.S. Malik, R. Ahmed, S.A. Khan and M.K. Bhatty (1985). Studies on essential oil of the Coleus aromaticus plant. Pak. J. Sci. Ind. Res. 28: 10-12.
- M.S. Malik, A. Rafi, S.A. Khan and M. K. Bhatty (1985). Studies on the essential oil of the Coleus aromaticus plant. Pak. J. of Scientific and Industrial Research, 28(1): 10-12.
- M.T. Buznego, H. Perez-Saad (1999). Antiepileptic effect of Plectranthus amboinicus (Lour.) Spreng Rev Neurol, 29:229-32.
- N. Andre, R. Topul, S.Otto (1995). Biological screening of traditional medicinal plants from Papua New Guinea. J. Ethnopharmacol. 49: 147-156.
- N.D. Kaliappan, P.K. Viswanathan (2008). Pharmacognostical studies on the leaves of Plectranthus amboinicus (Lour) Spreng; International Journal of Green Pharmacy: 2 (3); 182-184.
- O.P. Rout, K.K. Rout, R. Acharya, S.K. Mishra (2010), Preliminary Pharmacognostical and Phytochemical evaluation of Coleus aromaticus Benth. leaf.; IJPWR 1(4); 1-19.
- P. Brindha, E. Sasikala, M. Pappa, R. Bhima Rao and A.B. Kundu (1991). Pharmacognostic studies on Coleus aromaticus Benth. (Indian Borage). Bulletin of Medico-Ethnobotanical Research. 12(1-2): 17-31.
- P.K. Warrier, V.P. Nambiar, Ramankutty (1995). Indian Medicinal Plants, 1st ed, Orient Longman Limited, Madras, Vol IV ;315-317.

#### Coden : IJABPT Copyrights@2012 ISSN : 0976-4550

P.V. Sharma (1995). Dravyaguna Vijnana. Chaukhamba Bharati Academy, Varanasi, India, Vol. II, 461-463.

Plectranthus, (Last accessed on 10.06.2012) Available from: www. Wikipedia. Org/wiki/ Plectranthus\_am.

- R. Baskar, P. Varalaksmi, Amsaveni (1992). Changes in tissue enzymes produced by Coleus aromaticus experimental Urolithiasis. Indian Drugs, 29:254-8.
- R. Bos and F.H. Hendriks (1983). The compositions of essential oil in the leaves of Coleus aromaticus Bentham and their importance as a component of species antiapthosae. Pharm Weekly Sci. 26: 129-30.
- R. Patel, N. Mahobia, R. Gendle, B. Kaushik and S. Singh (2010). Diuretic activity of leaves of Plectranthus amboincus in male albino rats. Pharmacog Res., 2: 86-88.
- R. Sahaykhare, S. Banerjee, K. Kundu (2011), Coleus aromaticus Benth. A Nutritive Medicinal Plant of Potential therapeutic value; International Journal of Pharma and Bio Sciences; 2 (3);488-500.
- R. Vera, J.M. Mondon and J.C. Pieri buttesti (1992). Some Medicinal Plants of reunion, 7th Asian Symposium on Medicinal Plants, Spices and other Natural Products, (ASOMPS VII), Manila.
- R.C. Hole, A.R. Juvekar, G. Roja, E. Susan and S.F. D'Souza (2009)., Positive inotropic effect of the leaf extracts of parent and tissue culture plants of Coleus amboinicus on an isolated perfused frog heart preparation. Food Chemistry, 114(1): 139-141.
- R.K. Baslas and P. Kumar (1981). Chemical examination of essential oil of Coleus aromaticus Benth. Journal of Indian Chem. Soc. 58(1): 103-04.
- R.M. Kathiresan (2000). Allelopathic potential of native plants against water hyacinth Crop Protection 19: 705-708.
- R.N. Chopra, S.L. Nayar, I.C. Chopra (1956). The Glossary of Indian Medicinal Plants, CSIR, New Delhi, 74.
- S. Annapurani, R. Priya (1999). Antimutagenic, antitumourogenic and antigenotoxic effects of polyphenol extracts of selected medicinal plants. Indian J Nutr Diet, 36:431-5.
- S. Dutta (1959). Essential oil of Coleus aromaticus of Indian origin, Indian Oil and Soap J. 25: 120.
- S. Palani, S. Raja, R. Naresh and B.S. Kumar (2010). Evaluation of nephroprotective, diuretic and antioxidant activities of Plectranthus amboinicus on acetaminophen-induced nephrotoxic rats. Toxicol Mech Methods.; 20(4): 213-21.
- S. H. Perez, M. T. Buznego, V. M. Lianio, F. M. Perez and R. Menedex (2003). Neuropharmacological profile of Plectranthus amboinicus (Lour) Spreng. (Indian borage). Rev. Neurol.36: 98-99.
- S.S. Prasad, P. Naik and K.K. Vijayalaxmi (2002), Efficiency of Coleus aromaticus extract in modifying cyclophosphamide and mitomycin-C induced clastogenicity in mouse bone marrow cells, J. of Experimental Bio. 40(9): 1020-25.
- V. V. Sivarajan, I. Balchandran (1994). Ayurvedic Drugs & Their Plant Sources. Oxford & IBH Publishing Co Pvt. Ltd, New Delhi, 234.

International Journal of Applied Biology and Pharmaceutical Technology Page: 355 Available online at www.ijabpt.com