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Moorva – a Drug of Controversial Identity: Review

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ABSTRACT

Introduction: Over the past few years, there has been a huge surge of interest towards Ayurvedic system of medicine, and it has become a subject of intensive research for various aspects. However, variation in the languages and prevalence of folklore medicines has led to confusion in the true identity of different plants having similar name. Moreover, the description of a plant in the ancient literature is found in verses, having ample use of synonyms. These synonyms have caused controversy in the identification of plants and, hence, the correct source of the plant could be misleading.

Background: Since herbal products are generally prepared using extracts of plants known for particular activity, the controversial source sometimes may lead to preparation of inefficacious medicines.

Review Results: Substantial efforts are being made to standardize the Ayurvedic crude drugs as well as finished Ayurvedic medicines. However, these initiatives imperatively need establishing correct identity of the plant drug. Moorva is an important controversial drug in Ayurveda. Its roots are used for thetreatment of various disorders. Five different plants are considered as Moorva throughout India. Only preliminary pharmacognostic reports are available on these five species.

Conclusion: The present review aims at differentiating these five sources of Moorva roots, i.e., C. fragrans, H. isora, M. arenaria, S. roxburghiana and Marsdeniatenacissima.

1. Ayurvedic System of Medicine

India is a unique country that has one of the oldest, richest and most diverse cultural traditions associated with the systematic use of medicinal plants since the prehistoric times, and practiced from almost the very beginning of civilization. It is a country having variety of languages and population which are dependent on different tribal and folklore medicine, the knowledge of which has been accessed from hundreds of medical texts and manuscripts. Among the various systems of medicine practiced in India, Ayurveda is the oldest, and its origin can be traced back to Brahma, the creator of the Universe who taught science to the Devtas. Ayurveda aims to offer a better and longer life byrational use of substances of natural origin – herbal, animal, mineral or marine. The approach focuses to maintain the health of the people; treating the disease is considered secondary. At present, this ancient indigenous system of medicine which has been long forgotten, is being rediscovered. It is also increasingly gaining recognition in the West as an alternative and safe system of medicine. This new awareness about the merits of Ayurveda has created a general interest in herbal products all over the world (Nair, 2004).

2. Controversial Drugs in Ayurveda

Along with all its acclaimed merits, Ayurveda has its shortcomings too. In the present context, these are becoming more and more significant and assuming greater importance, as this is likely to lead to further deterioration of manufactured medicines. The most serious drawback of the Ayurvedic system of medicine is the difficulty in identifying the genuine medicinal herbs prescribed by the founders of the system (Nair, 2004). Quantum of information gained from Ayurvedic literature revealed that more than one common vernacular name is used for two or more entirely different plant species. '*Sandigdhadravyas*' is the term which is used to describe medicinal plants having controversial sources. Variation in the language sometimes is responsible for confusion in the nomenclature of different plants having similar name. Moreover, descriptions of a plant in

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the ancient literature are found in versus having ample use of synonyms. These synonyms have caused controversy in the identification of plants, and hence, the correct source sometimes is misleading with a fictious plant (Sethiya et al., 2009; Dobriyal and Ananthanarayana, 2009). Thus, due to lack of scientific names in the available Ayurvedic literature, under one name, different plants are known in different parts of the country as per the description, which makes the drug controversial (Wilson, 1864).

3. Groups of Drugs Used in Ayurveda

Ayurveda classifies medicinal plants according to their pharmacological action. Charaka has described drugs in groups for alleviating diseases. For example, *Arshoghana* (Sanskrit, *Arsh*: Blood loss; *Ghana*: killer or remover) contains ten drugs having beneficial effect in haemorrhoids. Another method adopted by Charaka is based on collection of three or more plants having identical properties in one group. Based on the physical forms of the different botanical sources, drugs have been grouped in different texts of Ayurveda. Table 1 lists some of the controversial drugs in Ayurvedic system of medicine (Singh, 2008; Vaidya, 1982; Lochan, 2007; Kumar et. al, 2015; Goel et. al, 2006).

Table 1: List of some controversial drugs in Ayurvedic system of medicine.

Ayurvedic name	**No. of plants**	**Botanical species linked to the drug**
Daruharidra	02	*Berberisaristata* (Berberidaceae) *Cosciniumfenestratum* (Menispermaceae)
Brahmi	02	*Bacopamoniera* (Scrophulariaceae) *Hydrocotyleasiatica* (Umbellifereae)
Amarvala	02	*Cascutareflexa* (convolvulaceae) *Cassyathafiliformis* (Lauraceae)
Punarnava	02	*Trianthemapartulacastrum* (Ficoidaceae) *Boerhaviadiffusa* (Nyctaginaceae)
Pasanabheda	11	*Saxifragaligulata* (Saxifragaceae), *Aervalanata*(Amaranthaceae) *Aervajavanica* (Amaranthaceae) *Ammaniabaccifera* (Lythraceae) *Bergenialigulata* (Saxifragaceae) *Bryophyllumcalcynum* (Crassulaceae) *Coleus aromaticum* (Labiatae) *Rotualaaquatica* (Boraginaceae) *Bridelia Montana* (Euphorbiaceae) *Homaniariparia* (Euphorbiaceae) *Ocimumbasilicum* (Labiatae)
Jivanti	03	*Leptadeniareticulata* (Asclepiadaceae) *Desmotrichunfimbritum* (Orchiaceae) *Cimicifugafoetida* (Ranunculaceae)
Shankhpushpi	04	*Convolvulus pluricaulis*(Convolvulaceae) *Evolvulusalsinoides*(Convolvulaceae) *Canscora decussate* (Gentianaceae) *Clitoreaternatea*(Papilonaceae)
Rasna	10	*Vanda tessellate* (Orchidaceae) *Alpinia galangal* (Scitaminaceae) *Pluchealanceolata* (Compositae) *Viscum album* (Loranthaceae) *Withaniacoagulans* (solanaceae) *Aristolochiaindica* (Aristolochiaceae) *Inularacemosa* (Compositae) *Rauwolfiaserpentiana* (Apocynaceae) *Lochnerarosea* (Apocynaceae) *Enicostemalittorale* (Gentianaceae)
Nagakesaram	03	*Mesuaferrea* (Guttifereae) *Ochrocarpuslongifolius* (Guttifereae) *Dilleniapentagyna* (Dilleniaceae)
Brahmi-dandi	03	*Argemonemexicana* (Papaveraceae) *Tricholepisglaberrima* (Compositae) *Echinopsechinatus*(Echinaceae)
Ashoka	03	*Polyalthialongifolia* (Anonaceae) *Saracaindica* (Caesalpiniaceae) *Shorearobusta* (Dipterocarpaceae)
Twak	03	*Cinnamomumtamala*(Lauraceae) *Cinnamomumzeylanicum* (Lauraceae) *Cinnamomum cassia* (Lauraceae)
Moorva	05	*Marsdeniatenacissima* (Asclepiadaceae) *Helicteresisora* (Sterculiaceae) *Maeruaoblongifolia* (Capparaceae) *Chonemorphafragrans* (Apocynaceae) *Sansevieriaroxburghiana*(Agavaceae)

4. Moorva: Controversial Ayurvedic Drug

Moorva is one of the controversial ayurvedic drugs used for the treatment of various disorders like intermittent fever, abdominal colic, urinary diseases, pruritus, constipitaion, diabetes mellitus, epilepsy, piles, typhoid, sterility, rigidity of lower limbs and skin diseases. One of the synonyms of this plant is 'Dhanurgunopayogya' meaning 'the plant whose bark is being used for making bow-strings', as the characteristic property of the plant is that it hasthe toughest fibres. Five different plant speciesare known to possess such properties, which are listed in table 1. Based on the physical forms, different plant species are accepted as Moorva in different parts of India. For example, *Helicteresisora* is considered as

Moorva in Punjab, *Maeruaarenaria* is used as Moorva in North-western India, *Chonemorphafragrans*is used as Moorva in Kerala, *Clematis trilobain* Gujarat and Maharashtra, *Bauhinia tomentosa* are used as Moorva in West Bengal, *Sansevieriaroxburghiana* in Bengal and Tamil Nadu, *Salvadorapersicain* Gujarat and Rajasthan, whereas *Marsdeniatenacissima* is an accepted source of Moorva in North India (Singh, 2002; Kulkarni and Shahida, 2004).

4.1. ***Chonemorphafragrans***

C. fragrans is popularly known as Garbhedaro (Hindi) or Moorva (Sanskrit) or Firangipani vine/Wood vine (English). It is native to India, Sri Lanka, South China, Singapore, Malaysia and Thailand. In India it is found throughout the dense moist forests of Karnataka, Kerala, Tamil Nadu and Andaman Nicobar Islands (Chandra and Rajput, 2011).

4.1.1 Morphology

C. fragrans is a stout spreading laticiferous shrub with soft greyish to rusty-brown bark. Leaves are large, orbicular, fulvous tomentose beneath and prominently veined. Flowers are whitish to cream-yellow in color, fragrant and in terminal or pseudo-axillary cymose panicle. Fruits are long, straight, woody, parallel with follicular mericarps. Seeds are many and flat in shape (Kulkarni et al., 2010).

4.1.2 Traditional uses

Various parts of *C. fragrans* have been used in Ayurveda for the treatment of one or the other disease or disorder. The plant is used to treat various types of inflammations and skin diseases. The roots are used as bitter tonic, astringent, laxative, thermogenic, depurative, carminative, anthelmintic, antiscorbutic, anodyne, expectorant and febrifuge. They are useful in vitiated conditions of vata and kapha, skin diseases, leprosy, scabies, dyspepsia,colic, constipation, hyperacidity, cardiac debility, diabetes, jaundice, cough, bronchitis and intermittent fevers (Chandrachood et al., 2009).

4.1.3 Pharmacological activities

4.1.3.1 Antiamoebic activity

Chonemorphine isolated from roots of *C. fragrans* exhibited significant antiamoebic and anti tricomonad activity (Madhavan et al., 2010).

4.1.3.2 Anticancer activity

Kedari and Malpathak (2013) have reported that the extracts of *C. fragrans* exhibit significant *invitro* anticancer activity comparable to camptothecin.

4.1.3.3 Skeletal muscle relaxant

Alcoholic extract of *C. fragrans* reduced the acetylcholine-induced contraction of isolated frog rectus abdominis and electrically stimulated contractions of rat phrenic nerve diaphragm in a dose-dependent manner. It produces depolarizing type of muscle paralysis similar to that produced by succinylcholine (Kumar et al., 2005)

4.1.3.4 Antioxidant activity

Crude extract of *C. fragrans* showed significant antioxidant activity in DPPH, FRAP, phosphomolybdenum and DNA prevention assay. The activity might be attributed due to the presence of phenolics and flavonoids (Madhavan et al., 2010).

4.1.3.5 Antibacterial activity

Extracts of *C. fragrans* inhibited the growth of both pathogenic and non-pathogenic bacteria, and are proved to be potent inhibitors of MDR bacteria (Madhavan et al., 2010).

4.1.3.6 Antidiabetic activity

Alcoholic extract of *C. fragrans* roots showed significant antidiabetic activity when administered orally at dose 100 and 200mg/kg in different conditions such as normal, glucose over loaded in normal rats and alloxan induced diabetic rats. Extract at the dose of 200 mg/kg significantly reduced blood glucose level in all the groups (Shah et al., 1989).

4.1.3.7 Hepatoprotective activity

Ethanol extract of *C. fragrans* roots showed significant hepatoprotective activity against paracetamol and isoniazid induced hepatotoxicity (Duraisankar et al., 2015).

4.2. Helicteresisora

H. isora is popularly known as Marorphali (Hindi) or Moorva (Sanskrit) or Nut Leaved Screw Tree (English). The plant is famous by the name Avartani/Avartaphala in Punjab. Theplant is widely found in Asian countries, mainly South China, Malayasia and India. In India, it is found in dry forests throughout Central India, Bihar, Punjab, Jammu and Western Peninsula (Kumar, 2014).

4.2.1 Morphology

H. isora is a sub-deciduous small tree or shrub of about 1.5-3.0 m height. Young branches are rough with scattered stellate hairs. Leaves are serrate, obliquely cordate or ovate, shortly acuminate, rough above and pubescent beneath. Flowers are solitary or in sparse clusters with red reflexed

petals, become pale-blue when old. Fruits are 5 cm long, greenish-brown, beaked and cylindrical with 5 spirally twisted carpels. The seeds are tubercled (Kumar et al., 2014).

4.2.2 Traditional uses

The plant has been employed in Ayurveda, Siddha and Unani system of medicine for treatment of a wide range of diseases. In Ayurveda, it is widely used as antidiarrheal, analgesic, wormicidal and blood purifier. The tribals of Singhum use the aqueous extract the roots for the treatment of dog bites. The fruits are used to treat constipation in new born babies (Kumar et al., 2014). In the Konkan, the plant is used in diabetes and for curing snake bites. The decoction of the fresh root paste after warming with turmeric powder is applied externally against cuts and wounds by the ethnic people of Rayalseema region of Andhra Pradesh (Quattrocchi, 2012; Dayal et al., 2015).

4.2.3 Pharmacological activities

4.2.3.1 Antidiabetic activity

Aqueous extracts of the bark of *H. isora* significantly reduced the plasma glucose, triglycerides and insulin levels in streptozotocin induced diabetic rats. Saponins isolated from *H. isora* show antidiabetic effects by activating the PI3K/Akt pathway, leading to phosphorylation and inactivation of GSK-3α/β with subsequent stimulation of glycogen synthesis as well as increase of glut4-dependent glucose transport across the cell membrane (Chakrabarti et al., 2002; Kumar et al., 2008; Bhavsar et al., 2009).

4.2.3.2 Hepatoprotective activity

Alcoholic extract of *H. isora* exhibited significant hepatoprotective activity against carbon tetrachloride induced liver damage in rats (Dhevi et al., 2008; Sable et al., 2012).

4.2.3.3 Hypolipidemic activity

Chakrabarti et al. (2002) have reported antidiabetic and hypolipidemic activity of ethanol extract of *H. isora* roots.

4.2.3.4 Anticancer activity

Methanol extract (50%) of plant showed antitumor activity in melanoma cells but protected normal human blood lymphocytes. Studies have also shown that the plant has potent action against human breast cancer (Varghese et al., 2011). Cucurbitacin B and isocucurbitacin B isolated from *H. isora* roots are responsible for activity (Bean et al., 1985).

4.2.3.5 Antioxidant activity

Aqueous and alcoholic extracts of fruits and bark of *H. isora* are reported to exhibit cytotoxicity against human lung cancer cells, and antioxidant activity such as free radical scavenging, toxicity to tumor cells, inhibition of nitric oxide and hydrogen peroxide radicals and protection of normal cells when compared to standards – L-ascorbic acid, quercetin and rutin (Kumar et al. 2012; Basniwal et al., 2009; Loganayaki et al., 2013; Bhat et al., 2012).

4.2.3.6 Antinociceptive activity

Petroleum ether, chloroform, ethanol, aqueous extracts of roots of *H. isora* showed significant antinociceptive activity on acetic acid induced writhing test in mice. The activity might be due to the presence of sterol, triterpenoids or glycosides (Kumar et al., 2014).

4.2.3.7 Antimicrobial activity

Aqueous and alcohol extracts of *H. isora* fruits showed antimicrobial activity against a number of bacterial strains. Aqueous extract of fruits showed prominent antibacterial activity against *E. coli*, *S. epidermidis*, *S. typhimurium*, *P. vulgaris*and moderate activity against *E. aerogones*, *S. aureus*, and *S. typhi* (Tambekar et al., 2008; Sriram et al., 2010).

4.3. Maeruaarenaria

M. arenaria is popularly known as Hemkand (Hindi) or Moorva (Sanskrit) or Desert Caper (English). It is native to India and is widely distributed in different states like Andhra Pradesh, Karnataka, Maharashtra, Orissa and Tamil Nadu. It is also distributed in other countries like Thailand, Sri Lanka, Pakistan, Arabia, Middle East and Africa (SasiPriya, 2020).

4.3.1 Morphology

M. arenaria is a woody climber found over *Maytenusemarginata*, *Prosopis cineraria*, *Tecomella undulate* and various species of *Salvadora*. It is an under shrub bushy plant, sometimes scadent, 2-3 m high with pale brown smooth bark and consists of thick root stock and leaves. Plant produces aromatic flowers especially during summer seasons. They are strongly scented and greenish-yellow or greenish-white in color, and are arranged in axillary and terminal corymbs. Calyx lobes are1.2 cm long and corolla lobes 6 to 7 mm long. Type of fruit is moniliform berry. The root goes deep into the soil which consists of a very stout tap root. It is slender, woody, and shaped irregularly. The roots are slightly yellowish with coconut pulp taste; diameter ranges from 1-9 cm. The surface of the fresh roots is brownish, smooth with concentric deep furrows and is very soft to touch. Dry roots are dark brown in colour (outside) whereas inner side is pale yellow in color (Rathore et al., 2011; Ekero et al., 2019; Moglad et al., 2014).

4.3.2 Traditional uses

The tuber of *M. oblongifolia* is medicinal and is eaten to quench thirst. Traditionally, the fleshy roots of this plant are used as aphrodiasiac, alternative tonic, blood purifier and energy stimulant. The plant is also used for treatment of Snake bite and Scorpion sting. Ethnomedical survey reveals that *M. oblongifolia* is used to cure various disorders also such as fever, stomach ache, skin infections, urinary calculii, diabetes mellitus, piles, typhoid, sterility, epilepsy, rigidity in lower limbs, abdominal colic, pruritis and some skin diseases (Moglad et. al, 2014). The plant is used alone or in the form of drink or smoke to treat different diseases in case of both humans and cattles (Ekero, 2018). Root are used to treat convulsions, sterility and as an aphrodisiac (Quatrochhi, 2012; Akila and Manickavasakam, 2014).

4.3.3 Pharmacological activities

4.3.3.1 Antipyretic activity

Aqueous and alcohol extract of *M. arenaria* showed significant antipyretic activity in Wistar albino rats by yeast inducing pyrexia. Significant reduction in rectal temperature was observed within 30 min of administration of either aqueous or alcohol extract. However, maximum temperature reduction was observed after 120 min of administration of the extracts (Madhavan et al., 2010).

4.3.3.2 Aphrodisiac activity

Dried root bark powder mixed with half spoon of honey when administered once a day for 2 months showed significant aphrodisiac activity (Rao et al., 2018).

4.3.3.3 Anti-fungal activity

Aqueous extract of *M. arenaria* leaves significantly inhibited the mycelial growth by 36.9% and spore germination by 69.1% of fungi species such as *A. solani*, *B. fabae*, *A. brassicae*, *F. oxysporum* and *P. infestans* (Baka et al., 2010).

4.3.3.4 Anti-microbial activity

M. arenaria was found to be effective against both gram positive and gram negative bacteria like *B. cereus*, *S. mutans*, *L. acidophilus*, *S. aureus*, *E. coli* and *K. pneumonia* when activity was tested by using minimum inhibitory concentration assay (Van Vuuren et al., 2010).

4.3.3.5 Anticonvulsant activity

Ethanol and water extracts of roots of *M. arenaria* at dose levels of 200 and 400 mg/kg, significantly reduced the extensor phase and the recovery time in MES induced seizures, whereas in PTZ induced convulsions both extracts at different doses had delayed the onset of convulsions and reduced the recovery time (Sundara and Madhavan, 2016).

4.3.3.6 Anti-diabetic activity

Aqueous extract of roots of *M. arenaria* significantly reduced the blood glucose levels at dose of 800 mg/kg in alloxan induced diabetes in Swiss albino mice. The results were comparable to standard drug glibenclamide (Arulanandraj et al, 2008).

4.4. ***Sansevieriaroxburghiana***

*S. roxburghiana*popularly known as Murahri/Marul-kalang (Hindi) or Moorva (Sanskrit) or Indian Bowstring Hemp (English). It is widely distributed in South and East India, Srilanka, Indonesia, Bangladesh and Myanmar. In India it is abundantly found Eastern in coastal regions (Moideen and Raffick, 2012).

4.4.1 Morphology

S. roxburghiana is an evergreen perennial creeper, producing succulent, erect, rigid leaves 45-75cm or more long and 25mm wide from a rhizomatous rootstock. Leaves are 10-20x2-4 cm flat, strap-shaped or narrowly lanceolate, with a subulate point up to 2.5 cm long. Inner or adult leaves ascending and slightly recurving, thick, deeply concave, channeled down the face, rounded or very obtusely keeled on the back, green, transversely marked with darker green lines on both sides. The leaf surface is smooth, the lower contrast and slightly rough. Flowers are borne in clusters of four, bract is narrowed 3 to 4 mm long and lanceolate. The flower tube is 6 to 7.5 mm long. The lobes are 8.5 to 9.5 mm in size (Obydulla, 2016).

4.4.2 Traditional uses

The leaves and roots of *S. roxburghiana* are used in traditional medicine for the treatment of asthma, abdominal pains, colic, diarrhea, hemorrhoids, hypertension, menorrhagia, piles, sexual weakness, wounds of the foot, cough, cardiotonic, expectorant, febrifuge, purgative,tonic, in glandular enlargement and rheumatism, leprosy, nutritional deficiencies and the treatment of snake bite (Moideen, 2012). Juice of tender shoots is given to children for clearing the phlegm from the throat (Obydulla, 2016).

4.4.3 Pharmacological activities

4.4.3.1 Anticancer activity

Aqueous extract of *S. roxburghiana* exhibited significant anticancer activity in brine shrimp lethality bioassay. Maximum toxicity was observed at LC50 value of 0.735 µg/ml compared to 0.544 µg/mlof standard vincristine (Haldar et. al, 2010).

4.4.3.2 Antidiabetic activity

S. roxburghiana rhizome demonstrated remarkable antidiabetic activity in STZ induced diabetic rats. The potential antidiabetic action is plausibly due to its modulation of endogenous antioxidant status (Haldar et. al, 2010).

4.4.3.3 Analgesic activity

Ethyl acetate soluble fraction of the crude methanol extract of *S. roxburghiana* significantly relieved pain at oral dose of 100 mg/kg in acetic acid induced writhing model in mice. The results were comparable to standard diclofenac sodium (Haldar et. al, 2010).

4.4.3.4 Antimicrobial activity

Various extracts of S. roxburghiana exhibited significant antimicrobial activity against both gram-positive and gram negative (Sethi, 2013; Moideen and Raffick, 2012) bacteria. Besides, ethyl acetate extract of rhizomes showed appreciable antifungal activity (Philip et. al, 2011).

4.4.3.5Antioxidant activity

Antioxidant effect was measured by DPPH free radical scavenging assay. Methanol extract along with its all fractions revealed mild to moderate free radical scavenging activity (Roy et al., 2012).

4.4.3.6 In Surgeries

Many synthetic materials have replaced the natural materials, which were once used for suturing in the ancient era, and Moorva is one of them. There are references of Murva (*Sansevieriaroxburghiana*Schult. and Schult.f.) at various contexts of "*Sushruta Samhita*" where it has been used as a suture material. Fifty incisions (Wards incision) placed for the surgical removal of mandibular third molar were sutured with Moorva, and followup was carried out postoperatively on 1st, 2nd, 3rd, and 7th day. Patients were evaluated for pain, swelling, bleeding, infection, wound dehiscence, local tissue irritation, and bacterial colonization. On various followups, progressively significant and predictable healing was observed without any uneventful evidence (Lambade, 2017).

4.5. ***Marsdeniatenacissima***

M. tenacissima is popularly known as Maruabel (Hindi) or Madhurasa (Sanskrit) or Rajmahal Hemp (English). The plant is native to China. In India it is found mainly in Kerala, Tamil Nadu and Orissa (Li et al., 2014).

4.5.1 Morphology

*M. tenacissima*is a perennial plant which grows up to a height of 2-6 m. The roots are cyclindrical and taupe in color. Stems are light brown to yellow in color with a diameter of 2-5 cm. These have cracks at the lower part. Leaf blades are unifoliate opposite, bottle green, have a circle of heart or broadly ovate form, 8-14 cm long, 5-9 cm wide, apex abruptly tapered or gradually acuminate, base subcordate, whole reason or slightly wavy, puberulous on lower surface and petiole 4–6 cm long. The flowers are corymbose cyme, axillary, small, sepals 5 cleft, lobed long round with a gland in the base of the inner surface, yellowish or yellowish red, and bell shaped. The fruits grow in pairs, have a long lanceolate, are 9 cm long, 1 cm in diameter and densely covered with grayish yellow pubescent (Wang et al., 2018).

4.5.2 Traditional Uses

Traditionally the stems of the plant are used to treat cough, cold, rheumatism pain and carbuncle (Wang et al., 2018).

4.5.3 Pharmacological Activities

4.5.3.1 Antitumor activity

Ethanol extract of the plant shows significant antitumor activity against haematologicneoplasma cells by inducing apoptosis both *in vitro* and *in vivo*(Ye et al., 2014).

4.5.3.2 Anti-Angiogenic activity

Extract of *M. tenacissima* inhibited the proliferation, migration and tube formation of human umbilical vein endothelial cells and reduced the formation of blood vessels in chick embryos (Huang et al., 2013).

4.5.3.3 Immunomodulatory activity

Polysaccharides isolated from *M. tenacissima* increased the serum hemolysin, promoted the formation of antibody-forming cells and improvde the phagocytosis of mononuclear macrophages in normal mice (Jiang et al., 2016).

4.5.3.4 Anti-HIV activity

Marstenacissides A1-A12 isolated from *M. tenacissima* when evaluated against HIV-1-infected SupT1 cells *in vitro*, showed significant results (Pang et al., 2016).

Conclusion

Long history of safe usage of Ayurvedic medicines can be extrapolated only when the botanical identity of the plants being used in these medicines, is established. Hence, proper nomenclature of all crude drugs, and establishing their exact botanical origin is a must.Thus, it has become an important task to generate parameters of identification as well as differentiation among different plant sources having similar name. On the basis of this review, five species of Moorva have been distinguished on the basis of their morphology, traditional uses and pharmacological activities.

Authorship Contribution

Dr Gulsheen: Data Collection and Manuscript Design
Dr Anupam: Manuscript Evaluation
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