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Hemidesmus indicus (L.) R. Br. A Review

Satheesh George, K.V. Tushar, K.P. Unnikrishnan, K.M. Hashim
and Indira Balachandran
Centre for Medicinal Plants Research, Arya Vaidya Sala, Kottakkal,
Changuvetty, Malappuram District, Kerala-676 503, India

Abstract: *Hemidesmus indicus* (L.) R. Br. (Periplocaceae) is being used widely in Ayurvedic medicine. The history of its medicinal importance dates back to ancient times. The present review deals with studies undertaken in various aspects of this plant in the areas of morphology, anatomy, pharmacology, chemistry and ethnobotany along with medicinal uses.

Key words: *Hemidesmus indicus*, Indian Sarsaparilla, review

INTRODUCTION

Hemidesmus indicus (L.) R. Br. (Periplocaceae) commonly known as Indian Sarsaparilla is a diffusely twining undershrub having numerous slender wiry laticiferous branches with purplish brown bark. This plant is found throughout India growing under mesophytic to semi dry conditions in the plains and up to an altitude of 600 m. It is quite common in open scrub jungles, hedges, uncultivated soil etc. It is found in India, Sri Lanka, Pakistan, Iran, Bangladesh and Moluccas (Sasidharan, 2004; Siddique *et al*., 2004; Anonymous, 2005; Nayar *et al*., 2006).

Vernacular Names

Arabic: Zaiyana, Ausaba lunnara; Beng.: Anantmool; Eng.: Indian Sarsaparilla; Guj.: Sariva; Hindi: Magrabu, Salsa, Kapooree, Anantamool; Kan.: Sogadeberu, Namadaberu; Konkani: Dudvali; Mal.: Naruninti, Nannari; Mar.: Anantmool, Upalsari, Dudhasali; Ori. : Onontomulo; Persian: Ushbanindi, Yasmine barri, Aushbahe nindi; Punj.: Anantmool; Sans.: Anantamula, sariva, naga jihva, gopakanya; Tam.: Nannari and Tel.: Gadisugandhi, Sugandhipala.

Synonym(s)

Periploca indica L. (Jagtap and Singh, 1999).

Hemidesmus indicus was formerly placed under the family Asclepiadaceae, but recently based on the pollinial characters it was transferred to Periplocaceae.

Ayurvedic Properties

Rasa-*tikta*, *Madhura*; guna-*guru*, *Snigdha*; Veerya-*sheeta*; Vipaka-*madhura*.

Doshaghnata: Tridoshashamaka; Rogaghnata: Daha, Shotha, Netrabhisyanda, Aruchi, Agnimandya, Atisara, Pravahika, Vatarakta, Phiranga, Upadansha, Amvata, Gandmala, Pradara, Garbhasrava, Stanyavikara, Shukradaurbalya, Mootrakrichchhra, Paittika prameha, Kushtha, Visarpa, Visphota, Jwara, Daurbalya, Pandu, Visha, Kasa, Shwasa; Karma: Rochana, Deepana, Pachana, Anulomana, Raktashodhaka, Shothahara, Kaphaghna, Vrishya, Stanyashodhana, Garbhasthapana, Mootrajanand, Mootravirajaniuhya, Kushthagna, Jwaraghna, Dahaprashamana, Rasayana and Vishaghna (Sharma *et al*., 2000).

Corresponding Author: Satheesh George, Centre for Medicinal Plants Research, Arya Vaidya Sala, Kottakkal, Changuvetty, Malappuram District, Kerala-676 503, India

Morphology

The stems and branches which twine anticlockwise are profusely laticiferous, elongate, narrow, terete and wiry of a deep purple or purplish brown colour with the surface slightly ridged at the nodes. Leaves: simple, petioled, exstipulate, opposite, entire, apiculate acute or obtuse, dark green above but paler and sometimes pubescent below. Leaves of the basal parts of the shoots are linear to lanceolate. Flowers: Greenish yellow to greenish purple outside, dull yellow to light purplish inside, calyx deeply five lobed, corolla gamopetalous, about twice the calyx, Stamens five, inserted near base of corolla with a thick coronal scale. Stamens five, inserted near base of corolla with distinct filaments and small connate oblong anthers ending in inflexed appendages. Pistil bicarpellary, ovaries free, many ovuled with distinct styles. Fruit two straight slender narrowly cylindrical widely divergent follicles. Seeds many, flat, oblong, with a long tuft of white silky hairs (Aiyer, 1951; Prasad and Wahi, 1965; Warrier *et al*., 2000).

Anatomy

Transverse section of the fresh root is circular with a fairly regular outline. It shows a slightly compact porous strand of wood at the centre enveloped by a massive cream coloured starchy tissue and a peripheral strip of light reddish brown rind (Aiyer, 1951; Sharma *et al*., 2000; Warrier *et al*., 2000).

Chromosome No: 2n = 22 (Jagtap and Singh, 1999)

Chemical Constituents

Different parts of the plant especially root contain various compounds (Fig. 1) such as 2-hydroxy 4-methoxy benzaldehyde, 4-hydroxy 3-methoxy benzaldehyde, lupeol, ledol, nerolidol, linalyl acetate, dihydrocarvyl acetate, cis-caryophyllene, isocaryophyllene, β-selinene, dodecanoic acid, hexadecanoic acid, camphor, borneol, dehydrolupanyl-3 acetate, dehydrolupeol acetate, 3-hydroxy 4-methoxy benzaldehyde, hexadecanoic acid, hexatriacontane, lupeol octacosanoate, β-amyrin acetate, lupeol acetate, α-amyrin, β-amyrin, sitosterol, drevogenin β-3-O-β-D-oleandropyranosyl, hemidesmin-1, hemidesmin-2, hemidesminine, phytosterols, triterpenes, saponin, resin acid, tannins, tetracyclic triterpene alcohols, fatty acids, glycosides, 16-dehydropregnenolone, a new pregnane ester diglycoside (desinine), indicine, hemidine and rutin are the chief components present in the plant (Chatarjee and Bhattacharya, 1955; Padhye *et al*., 1973; Mandal *et al*., 1991; Prakash *et al*., 1991; Das *et al*., 1992; Gupta *et al*. 1992; Chandra *et al*., 1994; Deepak *et al*., 1995; Roy *et al*., 2000; Sharma *et al*., 2000; Nagarajan *et al*., 2001; Nagarajan and Rao, 2003; Anonymous, 2005).

Propagation

Vegetative/Seed

Detailed studies on seed propagation have been done by Warrier *et al*. (2000). The seed germination percentage was 95.33. They have reported the occurrence of albino seedlings (1%) in *H. indicus*. According to them this plant does not respond satisfactorily to vegetative propagation by stem/root cuttings even after treatment. Rao *et al*. (2000) have reported enhanced rooting of *H. indicus* when treated using the 'quick dip' method in different concentrations of rooting hormones (IBA, IAA, NAA). Rooting was slow in the absence of hormone treatment but all species attained >70% rooting. Philip *et al*. (1991) have reported the vegetative propagation of *H. indicus* by means of stem and root cuttings. Ramulu *et al*. (2005) have reported the vegetative propagation of *H. indicus* by stem cuttings. Effect of cryopreservation on seed germination of *H. indicus* has been reported by Decruse *et al*. (1999).

Tissue Culture

Malathy and Pai (1998) have reported the *in vitro* propagation of *H. indicus*. Micropropagation was achieved in Murashige and Skoog's basal Medium (MS) supplemented with benzyladenine

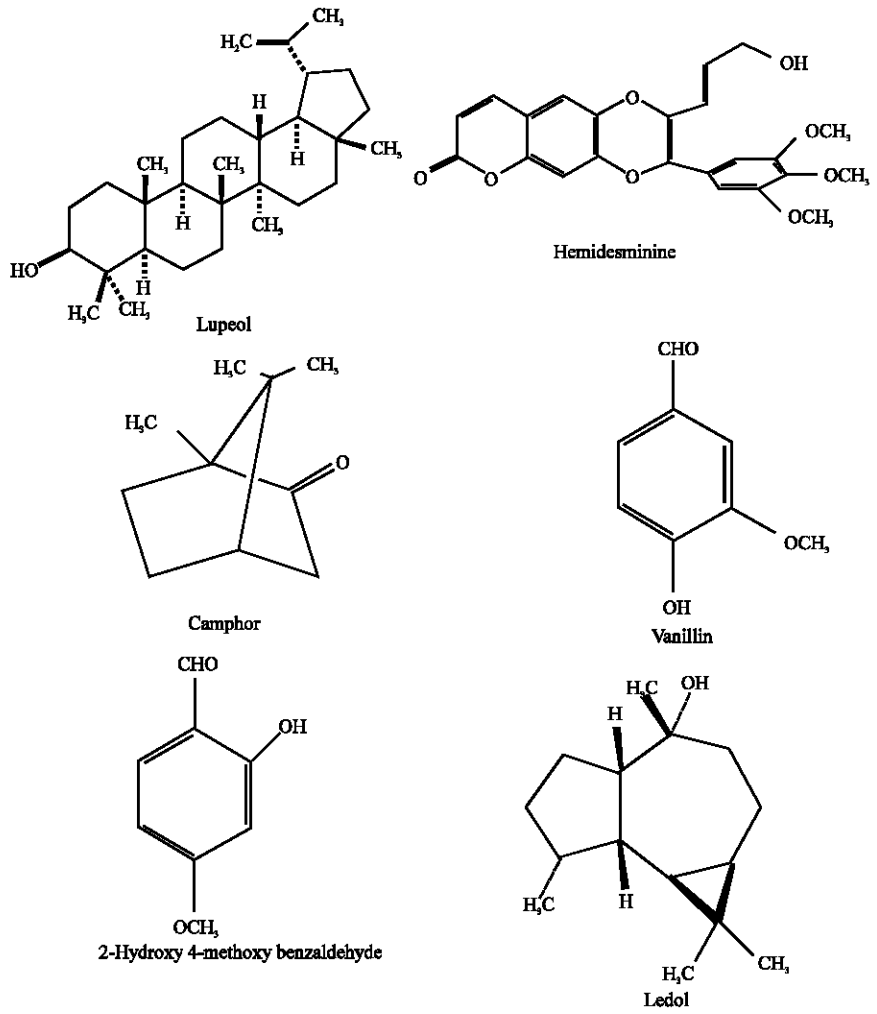

Fig. 1: Chemical structures of major compounds present in *Hemidesmus indicus* (L.) R.Br

(3 mg L^{-1}). Addition of low concentrations of ammonium nitrate increased the internodal length and thickness of shoots. Rooting was achieved on MS containing NAA (1 mg L^{-1}) and kinetin (1 mg L^{-1}). Micropropagation and production of 2-hydroxy 4-methoxy benzaldehyde using root cultures of *H. indicus* was reported by Sreekumar *et al.* (1998, 2000). Second and third visible nodes (0.5 cm) from the apex and root segments (0.5 cm) were the most and least regenerative, respectively, with the formation of 9.37 and 2.6 shoots in 4 weeks on half-strength MS medium supplemented with 2.22 and 1.07 μM NAA and 4.44 and 2.69 μM NAA, respectively. Caulogenic ability of the nodes decreased with increasing maturity. Nodal explants of the *in vitro* raised shoots subcultured in the same medium produced 9.32 shoots of 7.1 cm length in 3-4 weeks, similar to those of the mature-plant derived nodes. Shoot cultures were rooted in quarter-salt-strength MS medium containing 9.8 μM IBA. Nodal explants from shoot cuttings of *H. indicus* were cultured in the dark in half-strength MS medium fortified with IBA (indole-3-butyric acid) at 2 mg L^{-1}, producing 10-12 roots (1-2 cm) with minimal callusing in 10 days. These roots were cultured in the dark for 30 days in the medium of Gamborg *et al.* supplemented with 2 mg L^{-1} IBA and sucrose (4% w/v), at pH 5.6 with agitation at 70 rpm; this yielded 550 mg roots (dry weight) containing 0.18% 2-hydroxy-4-methoxybenzaldehyde.

Thomas *et al*. (1996) have reported multiple shoot induction from shoot tips/nodal segments in MS medium supplemented with NAA, BA (benzyladenine) and GA3 (gibberellic acid). Patnaik and Debata (1996) have reported micropropagation of *H. indicus* through axillary bud culture. Highest shoot multiplication rate of 8.2±0.4 shoots/explant with a 95% frequency was achieved in 5 weeks on MS medium supplemented with 1.15 μM kinetin and 0.054 μM NAA. Sarasan *et al*. (1991, 1994) have reported regeneration of *H. indicus*, through organogenesis and somatic embryogenesis. Organogenesis and somatic embryogenesis were induced from callus initiated from leaf and stem explants cultured on MS and B5 media supplemented with 2,4-D, NAA, BA and kinetin. Somatic embryogenesis was dependent on the type of explant, growth regulators and age of callus. Callus induced on MS medium containing 2,4-D and kinetin (1 mg L^{-1}) developed somatic embryos upon transfer to half strength MS basal medium. Organogenesis was induced in callus developed on MS medium containing NAA 2 mg L^{-1} and kinetin 0.5 mg L^{-1} and subcultured on medium with kinetin (1.5-2 mg L^{-1}) and 10% (v/v) coconut milk. Isolated shoots were rooted in half strength MS basal medium. Ramulu *et al*. (2003) have reported the regeneration of plants from root segments derived from aseptic seedlings. In their experiment auxins or cytokinin individually failed to initiate shoot buds from root segments. Formation of shoots from the proximal end of root segments was observed on the medium with cytokinins and alpha-naphthalene-acetic acid within 2 to 3 weeks. The highest number of shoots (5.02±1.01) was produced on the medium with 6-benzylaminopurine at 3 mg L^{-1} and alpha-naphthalene-acetic acid at 0.5 mg L^{-1}. Rapid elongation of shoot buds was observed upon transfer of the responding root segments to half strength MS medium. Jayanthi and Patil (1995), Sharma and Yelne (1995), Yelne *et al*. (1999), Ramulu (2001) and Saha *et al*. (2003) have also reported *in vitro* propagation of *H. indicus*. Studies on steroids in cultured tissues and mature plant of *H. indicus* have been reported by Heble and Chadha (1978). Improvement in clonal propagation of *H. indicus* through adenine sulphate has been reported by Neetha *et al*. (2003). Neetha *et al*. (2005) have reported *in vitro* biosynthesis of antioxidants such as lupeol, vanillin and rutin from *H. indicus* cultures. Somatic embryogenesis and plant regeneration from leaf cultures of *H. indicus* have been reported by Swaroopa and Dixit (2006).

Cultivars/Morphotypes/Chemovars

Occurrence of high rate of intraspecific variability has been reported. Micro and macro morphological studies of the vegetative and reproductive characters together with phytochemical studies of the accessions from different agroclimatic zones of India have been reported by George *et al*. (2006). A particular morphotype with increased lupeol content was reported by George *et al*. (2006).

Substitutes and Adulterants

Roots of four species viz., *Ichnocarpus frutescens* R. Br., *Cryptolepis buchanani* Roem and Schult., *Decalepis hamiltonii* Wight and Arn and *Utleria salicifolia* Bedd. ex Hook.f. (Prasad *et al*., 1964; Nair *et al*., 1978; Ramiah and Nair, 1982; Sharma *et al*., 2000; Warrier *et al*., 2000; Anonymous, 2001).

Market Trends

Retail market price-fresh root-Rs. 45 kg^{-1}; Root powder-Rs. 90 kg^{-1} based on the market study in 1999 (Sharma *et al*., 2000). Based on the market survey conducted by the author, it was found that the dried root of the plant costs Rs. 120 kg^{-1}.

Phytochemical Studies

Chemical composition of the volatiles of *H. indicus* was reported by Nagarajan *et al*. (2001). The volatiles obtained by steam distillation (yield, 0.25%) contained 2-hydroxy-4-methoxybenzaldehyde (91%) and ledol (4.5%), which are isolable in pure form, as the major constituents. The GC MS

analysis of the residual oil showed the presence of over 40 minor constituents. Among them, nerolidol (1.2%), borneol (0.3%), linalyl acetate (0.2%), dihydrocarvyl acetate (0.1%), salicylaldehyde (0.1%), isocaryophyllene (0.1%), alpha terpinyl acetate (traces) and 1, 8-cineol (traces) are important as aromatic and bioactive principles. Prabakan *et al*. (2000) have reported the protective effect of *H. indicus* against rifampicin and isoniazid induced hepatotoxicity in rats. Oral treatment with the ethanol extract of *H. indicus* roots (100 mg kg^{-1}, for 15 days) significantly prevented rifampicin and isoniazid induced hepatotoxicity in rats. Ethanolic extracts *H. indicus* was studied for their antimicrobial activity against certain drug resistant bacteria and a yeast *Candida albicans* of clinical origin (Ahmad and Beg, 2001). *In vitro* evaluation of inhibitory nature of extracts of *H. indicus* against 3 keratinophilic fungi viz. *Microsporum gypseum*, *Chrysosporium tropicum* and *Trichophyton terrestre* were evaluated (Sekar and Francis, 1998). Two novel pregnane glycosides, namely hemidescine and emidine, were isolated from the dried stem of *H. indicus* (Chandra *et al*., 1994). Mandal *et al*. (1991) have reported Hemidesminin-a new coumarino-Lignoid from *H. indicus*. Gupta *et al*. (1992) have reported a new triterpene lactone, characterized as 3-keto-lup-12-ene-21<right arrow>28-olide from the hexane soluble portion of the EtOH extract of the stem. Two new pregnane glycosides, designated indicine and hemidine have been isolated from the dried stems of *H. indicus* (Prakash *et al*., 1991). Roy *et al*. (2000) have done phytochemical studies of *H. indicus* in comparison with other plants equated with Sariva. Studies on triterpenoids from the roots of *H. indicus* have been reported by Padhye *et al*. (1973). Isolation of Indicusin-a pregnane diester triglycoside, β-sitosterol and new coumarinolignoids from *H. indicus* have been reported (Chatarjee and Bhattacharya, 1955; Das *et al*., 1992; Deepak *et al*., 1995).

Pharmacological Studies

The ethanol extract of *H. indicus* significantly prevented rifampicin and isoniazid induced hepatotoxicity in rats (Prabakaran *et al*., 2000). The chloroform and ethanol extracts were reported to possess antifungal activity against *Aspergillus niger* and weak antibacterial activity against *Staphylococcus aureus*, *Escherichia coli*, *Pseudomonas aeruginosa* (Hiremath *et al*., 1997). An organic acid isolated from root extract possesses viper venum inhibitory activity (Alam *et al*., 1994, 1996). Extracts significantly neutralized venom-induced lethality and haemorrhagic activity in rats and mice. Venom-induced coagulant and anticoagulant activity was also antagonized by the extract. The root extract has potent antiinflamatory, antipyretic and antioxidant properties (Dutta *et al*., 1982; Rao *et al*., 2005). The compound 2-hydroxy 4-methoxy benzoic acid has antivenum and antioxidant properties (Alam and Gomes, 1998a). The root bark also possess antioxidant activity (Ravishankara *et al*., 2002). The root extract demonstrated inhibitory activity against *Mycobacterium leprae* (Gupta, 1981) and keratinophilic fungi (Qureshi *et al*., 1997). The ethanolic extract was reported to be effective chemoprotective agent and prevented oxidative stress and tumour in skin (Sultana *et al*., 2003). The aqueous ethanolic extract of root collected during flowering season was found to possess significant antiulcer activity (Anoop and Jagadeesan, 2003). Satoskar *et al*. (1962) have also reported the pharmacological properties of *H. indicus*. The plant is also used against various skin diseases (Anonymous, 1989) and in the treatment of acne vulgaris (Lalla *et al*., 2001). Antimicrobial studies on essential oils of *H. indicus* have been reported by Prasad *et al*. (1983). Protective effect of *H. indicus* against rifampicin and isoniazid induced hepatotoxicity in rats has been reported by Prabakan *et al*. (2000). The plant is also reported to have anticancer, antihepatotoxic (Mandal, 1995; Hartwell, 1967) and antibiotic activities (Joshi and Nagar, 1952). Viper venum induced inflammation and inhibition of free radical formation by pure compound (2-hydroxy, 4-methoxy benzoic acid) isolated and purified from *H. indicus* has been reported by Alam and Gomes (1998b). Effect of cell culture derived *H. indicus* in the prevention of hypercholesterolemia in normal and

hyperlipidimic rats have been reported by Bopanna *et al*. (1997). Enhancement in the absorption of water and electrolytes from rat intestine by water extract of roots of *H. indicus* has been reported by Evans *et al*. (2004). Radiation protection of DNA and membrane *in vitro* by extract of *H. indicus* has been reported by Shetty *et al*. (2005).

Medicinal Uses

Bacteriostatic, anticancer, antiviral, antilithic, hypotensive, antifungal, antibacterial, anti-inflammatory, spasmodic activities have been reported. The milky latex of the plant is used for relieving inflammation in the eye. Ether extract of the root exerts some inhibitory effect on the growth of *Escherichia coli*. The leaves are chewed and are said to be refreshing; narrow leaved forms which are generally found in open country are preferred for this purpose (Anonymous, 2001).

Ethnobotany/Traditional Knowledge

There are reports regarding the use of *H. indicus* in various ethnomedical practices (Karnick, 1977). Use of this plant against leucorrhoea at Bargarh district in Orissa and Sattordem Village of Goa has been reported (Sen and Behera, 2000; Kamat, 2001). Antipyretic use of this plant has also been reported (Singh and Kumar, 1999). Banerjee and Pal (1994) and have reported the use of this plant by the tribals of plain land in India for hair and scalp preparation. Jain and Singh (1994) and Kothari and Moorthy (1994) have reported the use of this plant by tribes of Ambikapur district, Madhya Pradesh and Raigard district in Maharashtra respectively. Sharma and Boissya (2003) have reported the use of *H. indicus* by Mising tribes in Dhemaji District of Assam against menstrual problems. Singh (1994) has reported the use of *H. indicus* among the tribals of Sonbhadra district of southern Uttar Pradesh, India. Sahoo (1995) has reported the use of *H. indicus* as an ophthalmic drug among the tribes in Phulbani, Orissa. Ethnobotanical uses of *H. indicus* among the tribals of Nallamalais have been reported by Pullaiah *et al*. (1994). Siddique *et al*. (2004) have reported the use of *H. indicus* among the local people and herbal practitioners of Barind Tract of Bangladesh against diarrhoea, rheumatism, fever, headache, asthma, eye disease and wounds. Rajasab and Isaq (2004) have reported the use of *H. indicus* among the tribes of north Karnataka. Ayyanar and Ignacimuthu (2005) have reported traditional uses of *H. indicus* among the Kani tribals in Kouthalai of Tirunelveli hills, Tamil Nadu. Uses of *H. indicus* among the Korku tribe of Amravati district of Maharashtra have been reported by Jagtap *et al*. (2006).

Quantitative Standards

Foreign matter-Not more than 2.0%, Total ash-2.6-4.3%, Acid insoluble ash-15.5-18.8%, Alcohol soluble extractive-1.0-1.5%, Water soluble extractive-18.6-18.9% (Sharma *et al*., 2000).

H. indicus forms an ingredient of about 46 Ayurvedic preparations either alone or in combination with other drugs (Iyer, 1983). The lists of important Ayurvedic preparations are given below:

Dasamoolarishta, Dhanwamtharishta, Balamritham, Saribadyasavam, Anuthaila, Amrithadi enna, Aswagandhadi yamaka, Gandha taila, Chandanadi taila, Triphaladi taila, Dhanwamthara taila, Neeleedaladi taila, Pinda taila, Balaswagandhadi taila, Manjishtadi taila, Madhuyashtyadi taila, Mahabala taila, Lakshadi taila, Sanni enna, Sidharthadi taila, Agragrahyadi kashaya, Jeevanthyadi kashaya, Triphalamarichadi mahakashaya, Dasamoolabaladi maha kashaya, Drakshadi kashaya, Dhanwamthara kashaya, Mahathiktha kashaya, Mridweekadi kashaya, Vidaryadi kashaya, Satavaryadi kashaya, Saribadi kashaya, Marmagudika, Manasamithra vataka, Kalyanaka ghritha, Jathyadi ghritha, Dadhika ghritha, Naladadi ghritha, Panchagavya ghritha, Pippalyadi ghritha, Brihachagaladi ghritha, Mahakalyanaka ghritha, Mahakooshmandaka ghritha, Mahathiktha ghritha, Vasthyamayanthaka ghritha, Varahyadi ghritha, Madhusnuhi rasayana.

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