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

Satheesh George, K.V. Tushar, K.F. 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. (Periploceae) 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. (Periploceae) 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.: Anamtool; Eng.: Indian Sarsaparilla; Guj.: Suriva; Hindi: Magrabu, Salsa, Kapooeree, Anantamool, Kan.: Sagadeberu, Namadaburu, Konkani: Dudvali; Mal.: Naruninti, Nunnari; Mar.: Anantamool, Upalsari, Dudhasali; Ori.: Onontomulo, Persian: Ushbanindi, Yasmine barn, Aushbahe hindi; Punj.: Anantmool; Sans.: Anantamula, sariva, naga jilwa, gopakanya; Tam.: Nunnari 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 pollenial characters it was transferred to Periploceae.

Ayurvedic Properties

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


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

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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, flatt, 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, dihydromycrryl acetate, cis-caryophyllene, isocaryophyllene, β-selinene, dodecanoic acid, hexadecanoic acid, camphor, borneol, dehydrocuparene-3 acetate, dehydrocuparene 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-cleandropyranosyl, hemidesmin-1, hemidesmin-2, hemidesminine, phytosterols, tetracyclic triterpenes, 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 Decreuse 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
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/w), 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 Uleria 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 Naganarjun et al. (2001). The volatiles obtained by steam distillation (yield, 0.25%) contained 2-hydroxy-4-methoxybenzaldehyde (91%) and leed (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-eucine (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 hepatoxicity 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 gyipseum*, *Chrysosporium tropicum* and *Trichophyton terrestris* were evaluated (Sekar and Francis, 1998). Two novel pregnane glycosides, namely hemidesuccine and emidine, were isolated from the dried stem of *H. indicus* (Chandra et al., 1994). Mandal et al. (1991) have reported Hemidesminin-a new coumario-Lignoid from *H. indicus*. Gupta et al. (1992) have reported a new tripetene lactone, characterized as 3-keto-lup-12-en-21-ol from the hexane soluble portion of the EOH 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. (1975). Isolation of Inducin-a pregnane diter triglycoside, β-sitosterol and new coumarindiglignoids 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 (Prabakan et al., 2000). The chloroform and ethanolic extracts were reported to possess antifungal activity against Aspergillus niger and weak antibacterial activity against Staphylococcus aureus, Escherichia coli, Pseudomonas aerigiosa (Himmath et al., 1997). An organic acid isolated from root extract possesses vep 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 antiinflammatory, antipyretic and antioxidant properties (Dutta et al., 1982; Rao et al., 2005). The compound 2-hydroxy 4-methoxy benzoic acid has antivenen and antioxidant properties (Alam and Gornes, 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 antilulcer activity (Anoop and Jagadeesan, 2003). Satokar 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 venom 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 Gornes (1998b). Effect of cell culture derived *H. indicus* in the prevention of hypercholesterolemia in normal and
hypertolipidmic 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**

Antibiotic, antiseptic, antiviral, antiallergic, hypotensive, antiviral, antibacterial, anti-inflammatory, spasmolytic activities have been reported. The milky latex of the plant is used for relieving inflammation in the eye. Etcher 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 Bargari district in Orissa and Sattordem Village of Goa has been reported (Sen and Behera, 2006; Kamat, 2001). Antifungal use of this plant has also been reported (Singh and Kumar, 1999). Banerjee and Pal (1994) have reported the use of this plant by the tribes of plain land in India for hair and scalp preparation. Jain and Singh (1994) and Kothari and Moomty (1994) have reported the use of this plant by tribes of Ambikapur district, Madiya Pradesh and Raiguard 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 Nallamalai have been reported by Pulliah et al. (1994). Siddique et al. (2004) have reported the use of *H. indicus* among the local peoples and herbal practitioners of Barind Tract of Bangladesh against diarrhoea, rheumatism, fever, headache, asthma, ear disease and wounds. Rajasah 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 tribes in Keuthalai of Tirunelveli hills, Tamil Nadu. Uses of *H. indicus* among the Korku tribe of Annawadi 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:

- Dasamoolarshita, Dhanwanthararshita, Balamritham, Saribadyasavan, Amuthaila, Amritadi enna, Aswagandhadi yaksha, Gandha taila, Chandanadi taila, Triphaladi taila, Dhanwanthara taila, Neelagandhadi taila, Pinda taila, Balasawagandhadi taila, Manjishadi taila, Madhuyashtyadi taila, Mahabala taila, Lakshadi taila, Sann enna, Sidharthadi taila, Agrahayadi kashaya, Jeena vishayadi kashaya, Triphalamarichadi malakashaya, Dasamoolabali mela kashaya, Drakshadi kashaya, Dhanwanthara kashaya, Mahathukha kashaya, Mriddvekadi kashaya, Vidarayadi kashaya, Satavaryadi kashaya, Saradi kashaya, Marnagadika, Manasamithra vataka, Kalyanaka ghritha, Jathyadi ghritha, Dadhika ghritha, Naladadi ghritha, Panchagavya ghritha, Pippalyadi ghritha, Brihaghaladi ghritha, Mahakalyanaka ghritha, Mahakooshmandaka ghritha, Mahathiktha ghritha, Vasthiyamayantaka ghritha, Varahyadi ghritha, Madhusnuhi rasayana.
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