Review Article

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# *HEMIDESMUS INDICUS* (ANANTMOOL): A POTENTIAL TRADITIONAL PLANT WITH ANTIVENOM ACTIVITY

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**ABSTRACT**

The field of Ayurvedic Science is acquiring more importance and prevalence all through the world as a result of its amazing medicinal uses. Therapeutic plants have been utilized by humankind since ancient times. According to World Health Organization, 80% of individuals depend on natural drugs for some aspect of their primary healthcare. *Hemidesmus indicus* (Anantmool) is a significant medicinal plant, which is described in Ayurvedic literature and current science because of the presence of its number of remedial properties. *Hemidesmus indicus* is locally known as Anantmool and Indian Sarsaparilla. It is an aromatic, long-rooted plant that belongs to the Apocynaceae family. The plant is widely cultivating in deciduous forests, uncultivated lands and moist hedges. The medicinal plant is used against a variety of diseases due to the presence of various phytochemicals like Hemidesmol, Resin, Glucoside, Tannin and Resin. The plant parts, roots and rhizome have been utilized for hundreds of years in Ayurvedic medication for relieving countless diseases. Many reported studies highlighted the potential pharmacological properties of *H. indicus* like anti-cataractous, anti-diarrhoeal, anti-cancerous, anti-diabetics, anti-venom, anti-angiogenic. The present work aims overall Ayurvedic and modern therapeutical information of *Hemidesmus indicus* with various reported Ayurvedic literature and scientific pharmacological studies.

**Keywords**: Anantmool, *Hemidesmus indicus*, Anti-venom, Lupeol, Indian Sarsaparilla

## INTRODUCTION

Herbal formulations are significantly utilized for their therapeutic uses and have become progressively popular worldwide[1]. Herbal drugs or formulations have lesser side effects than synthetic formulations. The potency of herbal medicine can be improved by modern pharmacological methods[2]. Several plants are used in the traditional medicinal system as well as modern medication system[3]. *Hemidesmus indicus* is a well-known drug in the traditional medicinal system[4] and Indian Pharmacopoeia[5]. *Hemidesmus indicus* (Figure 1) is an aromatic climbing plant commonly known as “Anantmool” or “Indian sarsaparilla”. It belongs to Apocynaceae Family[4]. Anantmool is a combination of two words that is Anant + mool (Anant means eternal and mool means root) so Anantmool means "the external root"[5]. Various scientific studies demonstrated that *H. indicus* has been assigned to different families. Banerjee *et al*. stated that *H. indicus* belongs to the Periplocaceae family, Efloras *et al*., demonstrated the herb belongs to Asclepiadaceae family and The Plant List 2020 assigned it under the Apocynaceae family. But now *H. indicus* has belonged to Apocynaceae following phylogenetic classification[6-8]. *H. indicus* has two varieties black and white. The Black variety is known as Krishna Sariva and the white one is known as Sariva[9]. It includes various phytochemical compounds like Hemindicusin, Coumarinolignoids, Hemidesmin-1, Hemidesmin-2, 2-hydroxy-4-methoxy benzoic acid (HMBA), 2-hydroxy-4-methoxy benzaldehyde (MBALD), 4-hydroxy-3-methoxy benzaldehyde (vanillin), 3-hydroxy-4-methoxy benzaldehyde (isovanillin), lupeol acetate, hindicusine and di-Oacetylhindicusine and β-amyrin palmitate[10] that possess various potential activity like anti-inflammatory, antioxidant, Analgesic, antipyretic, hepatoprotective, antileprotic, anti-acne, antimicrobial, anti-carcinogenic, antithrombotic, anti-hyperlipidaemic, anti-nociceptive, anti-venom and wound healing activity. All parts of *Hemidesmus indicus* have been considered as a crude drug but the root part of the plant displays a wide range of medicinal, biological and phytopharmaceutical properties[11]. Initially, the herb was employed under the name of *Smilax aspera* for some time[12]. *H. indicus* is considered as one of the Rasayana plant of Ayurveda. This herbal plant is utilized in the markets of the USA in the forms of polyhedral formulations as oils or creams and as oral tablets[13]. Many types of research on the herb *H. indicus* have to be potentially tapped in a commercial way for the production of medicinal products[14]. This review paper aims to provide whole information on the general basis, phytochemical and reported therapeutical studies of plant *H. indicus*. Taxonomy and vernacular names[15] of *H. indicus* are given in Table 1 and 2 respectively.

**Table 1: Vernacular names for *H. indicus***

| | |
|---|---|
| English | Indian Sarsaparilla |
| Hindi | Magrubu |
| Kannada | Namada-beru |
| Sanskrit | Anantmul |
| Tamil | Arakkam |
| Assamese | Anantamul |
| Bengali | *Anantamul* |
| *Gujarati* | *Upalsaari* |
| *Konkani* | *Uparsal* |
| *Malayalam* | *Nannaari* |
| *Manipuri* | *Anantamul* |
| *Marathi* | *Anantavel* |
| *Oriya* | *Suguddimalo* |
| *Telugu* | *Sugandhi* |
| Others | *False Sarsaparilla, Kir Magalie, Indian Sarsaparilla* |

**Table 2: Botanical Classification of *H. indicus***

| Taxonomical Rank | Taxon |
|---|---|
| Kingdom | Plantae |
| Phylum | Tracheophyta |
| Class | Magnoliopsida |
| Order | Gentianales |
| Family | Asclepiadaceae |
| Genus | *Hemidesmus* |
| Species | *Indicus* |
| Common Name | Indian Sarsaparilla |

**Botanical Description of *H. indicus***

*Hemidesmus indicus* (Anantmool) is a perennial, slender, lactiferous and twinning climbing vine shrub. It has long, cylindrical, slightly twisted aromatic roots and brown-coloured bark. Stems are slender and having thickened nodes[16]. The leaves are simple, shortly petioled, exstipulate, opposite, entire, smooth, acute and striated down the middle with white colour. The mature leaves are generally broad lanceolate, sometimes ovate or oval. It is 5-10 cm long dark green with reticulate veins. Flowers are greenish-purple in colour. It is crowded in sub-sessile cymes with opposite axils. Fruits are cylindrical and long up to 10 cm. Seeds are flat, oblong with a long tuft of white silky hair[17,18].

**Figure 1: *Hemidesmus indicus* (Anantmool)**

**Geographical Distribution**

*H. Indicus* is widely distributed in India, Pakistan, Sri Lanka, Bangladesh, Iran, Iraq and Indonesia. It is cultivated at an altitude of 600 m. In India, it is distributed through the Gangetic Plain, the arid region of the Chota Nagpur and the southern dry regions. It is commonly growing in deciduous forests, uncultivated lands and moist hedges[19,20].

**Phytochemical Constituents**

*H. indicus* shows the presence of alkaloids, steroids, terpenoids, flavonoids, saponins, phenolic compounds, tannins, insulin, lignin and cardiac glycosides. The different parts of *H. indicus* are having several phytochemicals[21]. But roots were investigated as a predominant source of phytochemical compounds. The root part of *H. indicus* possesses Hemidesmol, Resin and Glucoside, tannin and resin[22], lupeol acetate, B- amyrin acetate; Hexa-Tricon ate acid, lupeol 1-octacosanol, steroid, terpenoids, flavonoid and saponin[23]. The herb also contains 80% of crystalline material glucose Hemidesmol, Glucoside, resin acid, 2-hydroxy-4-methoxy, 4-hydroxy 3-methoxy benzaldehyde, lupeol, ledol, nerolidol, linalyl acetate, dihydrocarvyl acetate, cis-caryophyllene, isocaryophyllene, B-selinene, dodecanoic acid, hexadecanoic acid, camphor, borneol, dehydrolupanyl-3 acetate, dehydrolupeol acetate, 2-hydroxy 4-methoxy benzaldehyde, hexadecanoic acid, hexatriacontane, lupeoloctacosanoate, B-amyrin acetate, lupeol acetate, α-amyrin, β-amyrin, sitosterol, drevogenin, β-3-O-β-D-oleandropyranosyl, hemidesmin-1, hemidesmin-2, hemidesminine, phytosterols, triterpene, saponin, resin acid, tannins, tetracyclic triterpene, resin acid, tannins, tetracyclic triterpene alcohols, fatty acids, glycosides, 16-dehydropregnenoline, Pregnane ester diglycosides[24]. The three new pregnenolone glycosides and condensed phenylpropanoid were also isolated from HPLC analysis of the root extract of *H. indicus*[25]. Glycosides are present in the stem part of the *H. indicus*. Hemidines are the glycosides isolated from the stem[26]. The alcoholic extract and chloroform of stem yield two pregnane glycosides, hemidescine and emidine[27]. From the leaves of *H. indicus* 2.5% of tannins, coumarin olignoids hemidesminine, hemidesmin 1, and hemidesmin 2 are isolated. The new compound Coumarin and Olignoids were rare naturally occurring compounds which possess cytotoxic and anti-hepatotoxic properties[28]. Some major phytochemical compounds are mentioned in Figure 2.

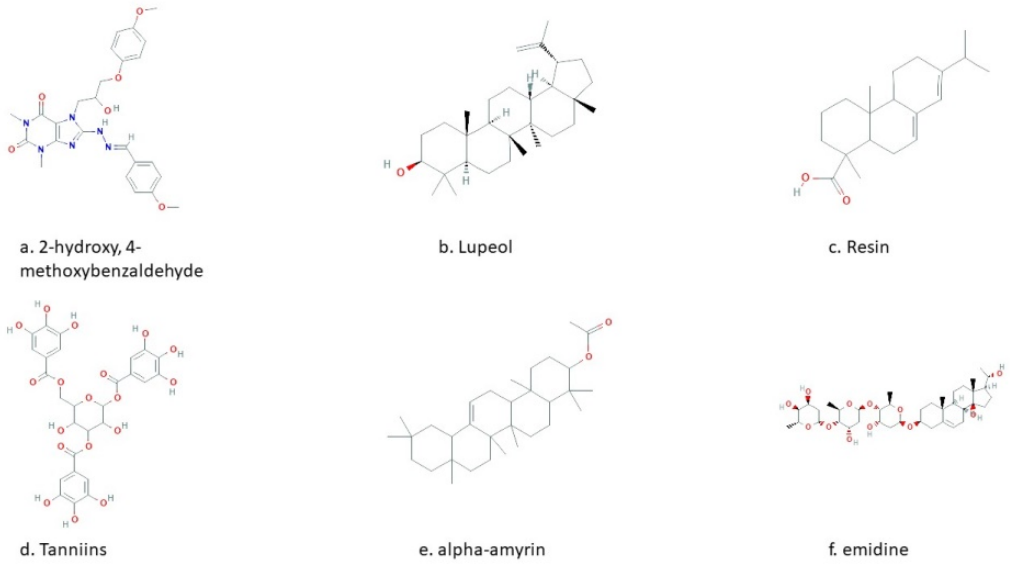


**Figure 2: Some major phytochemical constituents of the *H. indicus***

**Ayurvedic View**

*H. indicus* (Anantmool) is an important therapeutic plant which belongs to the Family Asclepiadaceae that is derived from the word Askleplos. The meaning of Askleplos is "God of medicine"[29]. *H. indicus* is also known as Sariva and Anantmool is a Sanskrit synonym which means 'endless roots'[30]. Kulkarni *et al*. have been reported Anantmool as a Medhya dravya. Medhya dravya in Ayurveda means something related with the treatment of Psychological disorder[31]. It comprises three mental capacities i.e. Dhee, Dhriti and Smriti. All three are interrelated to each other. The researchers have proved that *H. indicus* having Tridoshamaka activity and enhance "Dharan Karma" (retention)[32,33]. Rasa Panchaka of *H. indicus* (Anantmool) is shown in the Table 3.

According to Charka Samhita *H. indicus* (Anantmool) is classified in the following groups[34]

- Varnya ter (Complexion enhancing drugs)
- Kandhya (Beneficial for throat and voice)
- Stanyashodhan (Purifies Breast Milk)
- Purishsangrahaniya (Drugs that find maintains the motion)
- Jwarahara (anti-pyretic)
- Dhahaprashaman (Destroys burning sensation)

**Table 3**: **Rasa Panchaka of *H. indicus* (Anantmool)**

| Sanskrit /English | Sanskrit / English |
|---|---|
| Vipaka/Metabolic Property | Madhura/ Sweet |
| Veerya/Potency | Sheeta/Cold |
| Guna/Physical Property | Guru, Snigdha / Heavy, Oily |
| Rasa/Taste | Madhura, Tikta / Sweet, Bitter[35] |

**Some significant properties (Karma) of Anantmool are**

**Bhavprakash Nighantu**: Shukral (Aphrodisiac), Tridosha-Shamaka (alleviates all three Doshas)[36,37]

**Dhanvantari Nighantu:** Kanduhara (destroys itching), Raktapittahara (Useful in Raktapitta disease), Kaphavatasranashanam (alleviates Kapha, and useful in Vatarakta diseases), Raktapittahara (useful in Raktapitta disease)[38].

**Raj Nighantu**: Kanduhara (destroys itching), Durgandhunashan (destroys foul smell)

**Many Ayurvedic formulations are containing *H. indicus* that are mentioned below**

Jwarahara mahakashaya, Caps HT2, Arogh, Ashwagandhadi lehya, Dashamularishta, Jatyadi ghrita, Chondrokola Rosh, Manjishthadi Kashayam, Balaashwagandha taila, Ashtamangal ghrita, Pinda tailam, Chandrakala rasa, etc.

**Folk View**

The ethnobotanical studies of *H. indicus* depicted various therapeutic uses. The herb was utilized in biliousness, blood diseases, diarrhoea, respiratory disorders, skin diseases, syphilis, fever bronchitis, asthma, eye diseases, epileptic fits in children, kidney, urinary disorders, loss of appetite, burning sensation and rheumatism[39,40]. The root part of *H. indicus* was considered as the most significant part of the herb. The root powder of *H. indicus* with the fruit of few other plants like *Calophyllum inophyllum, Diospyros ebenum, Terminalia chebula, Terminalia bellirica*, *Phyllanthus emblica* and honey is taken to increase semen production. In Tamil Nadu, the roots of *H. indicus* are called "Nannari". This herb is locally known as sogada and used to cure thirty-four types of diseases. Various studies have been reported the folk uses of the *H. indicus* Plant. Sen *et al*., have been reported that *H. indicus* works against leucorrhoea at Bargarh district in Orissa and Sattorden Village of Goa[41]. Singh *et al*. have been reported that this plant possesses antipyretic activity[42]. Siddique *et al*. reported in their study that *H. indicus* were used by local people and herbal practitioners of Barind Tract of Bangladesh for the treatment of diarrhoea, rheumatism, fever, headache, asthma, eye disease and wounds[43]. Rajasab *et al*. investigated that the herb was used among the tribes of north Karnataka[44]. Jagtap *et al*. have been reported the uses of *H. indicus* among the Korku Tribe of Maharashtra[45].

**Modern View**

The consumption of herbal medicines has increased world widely. Reported studies have revealed an increased growth in the sale of herbal products from the year 2000 to 2008 ranges from 3% to 12% per year[46]. Due to the increased demand for herbal products, the risk with the herbal medicines also rises as the quality of the end products, compromises because of the contamination of raw material with toxic metals microbes, other residues and adulteration (addition of fake or inferior plant material, orthodox drugs, foreign material) which results in the poor quality of raw material and end products[47]. Internal issues like non-uniformity (rises due to environmental factor and geographical distribution, use of pesticides, fertilizers) and complexity in the ingredients of herbal medicines also rises which is affecting the quality of herbal medicines[48]. Lack of standardization technique is also responsible for the poor quality of drugs as it fails to detect the original drug which exploits its usage in the conventional system of medicines[49]. The development of new herbal dosage formulations without affecting the principal component is the present-day need. There are various formulations produced from the plant *Hemidesmus indicus* which is introduced as oil, creams and seeds packet. The root extract has medicinal value and is used for the treatment of rheumatism, in human and animal skin diseases. Modern science utilized its effect for commercial benefits. There are many modern formulations introduced in the market which consist of *H. indicus* like Anti-dandruff shampoo, cream, Ashwagandharishta, Sariva syrup and many more[50].

**Therapeutic Uses of *Hemidesmus indicus***

Therapeutic activities of *Hemidesmus indicus* have been reported in several research articles from the past to the present day time. There is an increasing demand for novel, safe and efficient therapies. The phytochemical compounds of *H. indicus* are a natural source of new drugs. The isolated compounds from the various part of the herb need to be further evaluated for their applications. Many *in-vitro* and *in-vivo* studies have been mentioned below defining with various pharmacological activities of *H. indicus*.

***Anti-inflammatory Activity***

The ethyl acetate root extract of *H. indicus* showed anti-inflammatory activity in the rats. The extract was less active than phenylbutazone but showed sufficient results when compared to diclofenac sodium gel[51,52].

***Antioxidant Activity***

The methanol extract isolated from the root bark of *H. indicus* inhibited of lipid peroxidation, hydroxyl and superoxide radicals in rat models[53]. The extract also protected the free radical-mediated oxidative stress in the plasma, erythrocytes and

liver[54,55]. One more study on Polymorph nuclear leukocytes and monocytes treated with *Propionibacterium acnes* in the presence of *H. indicus* showed significant suppression of ROS and pro-inflammatory cytokines in the acne pathogenesis[56].

***Anti-cancerous activity***

The roots of the *H. indicus* showed protective activity against cancers[57]. From reported studies the Chemo preventive effect of *H. indicus* extract on acute lymphoblastic leukaemia cell line (CCRF-CEM) exhibited cytotoxic effect[58]. The aqueous extracts of *H. indicus, Rubia cordifolia* and *Mimosa pudica* have enhanced the angiogenesis in the chorioallantoic membrane model[59]. The root decoction was reported to have cytotoxic, cytostatic and cyto-differentiation activity in the human promyelocytic leukaemia cell line (HL-60)[60].

An *in-vivo* study on rats showed anti-cancerous activity. The aqueous extract of *H. indicus* with *Nigella sativa* and *Smilax glabra* inhibited the diethylnitrosamine mediated carcinogenic changes and prevented DMBA-initiated and TPA- Promoted skin carcinogenesis[61].

***Hepatoprotective Activity***

The ethanol extract of the *H. indicus* was given orally to the Wistar rat. It was than evaluated that it prevented rifampicin and isoniazid-induced hepatotoxicity in the rat[62].

***Anti-arthritic Activity***

The *H. indicus* roots showed protective activity against arthritis. This is probably due to presence of terpenes, sterols, and phenolic compounds in hydro alcoholic root extract and ethyl acetate fraction. In reported studies it was found that these fractions of *H. indicus* showed higher anti-arthritic activity than chloroform and residual fraction[63]. A study was conducted on the ovariectomized rats and result showed that it prevents bone loss in dorsal ovariectomy-induced osteoporosis without estrogenic effects[64].

***Anti-angiogenic Activity***

The root extract of *H. indicus* showed anti-angiogenic activity. *In-vitro* activity of the extract was assessed on the human umbilical vein endothelial cells. Several interactions with crucial steps in angiogenic cascade targeting VEGF expression triggered by HIF- 1α and also endothelial cell migration and differentiation[65].

***Anti-diabetes Activity***

The alcoholic extract of *H. indicus* was evaluated for its anti-diabetes activity in rats. 400 mg/kg ethanolic extract was administrated for 4 weeks that decreased serum cholesterol, triglycerides, free fatty acids, phospholipids and sugar levels[66]. One more study was conducted for the anti-diabetic activity on streptozotocin-induced diabetic rats. It was found that the crude aqueous extract and HMBA produced hypoglycaemic and hypocholesterolemic effects[67]. It was also examined from the study that β-amyrinpalmitate present in root extract to have anti-diabetes potential at low concentrations in alloxan and streptozotocin-induced diabetic rats.

The anti-diabetes potential of *H. indicus* was evaluated by Gayathri *et al*., in the rat model in which diabetes was induced artificially by streptozotocin, 2-hydroxy-4-methoxy benzoic acid of the roots were comparatively studied. It was found that the extracts caused a significantly elevated activity of total ATPases, Na/K ATPase, $Mg^{2+}$ -ATPase and $Ca^{2+}$ -ATPase and decreased catalase, superoxide dismutase, glutathione peroxidase, Glutathione-S-transferase in erythrocytes[68].

***Anti-cataractous Activity***

The methanol root extract of *H. indicus* was examined for its anti-cataractous activity in streptozotocin-induced diabetic rodents. It was found that the extracts significantly inhibited aldose reductase activity, lowered blood glucose; delayed progression of cataract decreased osmotic stress and prevented the loss of antioxidants[69].

***Antivenom Activity***

The root extract of *H. indicus* was reported to reduce inflammation produced by Viper venom. It was found that the extracts reduced reactive oxygen species and inflammatory cytokines also. Viper venom-induced coagulant and anticoagulant activity was neutralized by the root extract[70].

***Anti-HIV activity***

As per the reported study phytochemicals of *H. indicus* possesses efficacy towards HIV-1 virus[71,72]. The anti-HIV-1 activity of HI was evaluated and it was found that *H. indicus* inhibited RT-associated RNase H function, HIV-1 RT-associated RNA-dependent DNA polymerase activity and cellular α-glucosidase[73].

***Antibacterial activity***

Spherical silver nanoparticles of *H. indicus* were synthesized and evaluated for their antibacterial efficacy against *Shigella sonnei* isolated from poultry gut. It was found that silver nanoparticles of *H. indicus* plant leave exhibit higher inhibitory activity against the bacteria[74].

***Diuretic activity***

Aqueous and ethanol crude extracts of the *H. indicus* were evaluated for their diuretic activity in the rats. It was found that the extract significantly increased the urine output in higher doses using acute rat models, without alterations in pH and specific gravity[75-77].

***Nootropic activity***

Reported studies showed that the n-butanol decoction of *H. indicus* root significantly improved learning power and memory in mice. Therefore, it was reported that *H. indicus* is a useful memory restorative agent in the treatment of dementia seen in Alzheimer's diseases[78].

***Antileprotic activity***

Aqueous extract of *H. indicus* was orally administrated at 2% concentration in mice. The mice were infected with *Mycobacterium leprae* from leprosy patient. It was found that cutaneous hypersensitivity stimulation was delayed and also plant possessed immunomodulatory activities[79].

***Antiulcer activity***

Austin *et al*. studied the antiulcer potential of *H. indicus*. Antiulcer activity was due to mucoprotective action of plant and it significantly inhibited prostaglandins. In comparison with standard drugs like omeprazole, ranitidine, *H. indicus* showed more mucoprotective activity[80].

**Table 4**

| Extract | Method | Property | References |
|---|---|---|---|
| Ethyl Acetate Extract | *In-vivo* study on rat models | Anti-inflammatory | [51,52] |
| Methanol extract | *In-vivo* study on rat models | Anti-oxidant | [53,54,55,56] |
| Root extract | *In-vivo* study on rat/mice | Anti-cancerous | [57,58,59,60] |
| Ethanol extract | Wistar rat | Hepatoprotective | [62] |
| Hydro alcoholic root extract | *In-vivo* study on Rats | Anti-arthritic | [63,64] |
| Root extract | *In-vitro* cell line study | Anti-angiogenic | [65] |
| Ethanolic extract/crude aqueous extract/ β-Amyrin palmitate | *In vivo* study on diabetic rats | Anti-diabetic | [66,67,68] |
| Methanol extract | *In vivo* study on diabetic rodent | Anti-cataractous | [69] |
| Root extract | *In-vivo* study on rats | Antivenom | [70] |
| Spherical silver particles of H. indicus | *In-vitro* study on rats | Anti-bacterial | [74] |
| Ethanol crude extract | *In-vivo* study on rat | Diuretic activity | [75,76] |
| n-butanol fractions of ethanolic extract | *In-vivo* study on mice model | Nootropic | [77] |

## CONCLUSION

In this present review, we have summarized the basic information, phytochemical constituents, Ayurvedic uses, modern uses and various reported therapeutic studies of *Hemidesmus indicus*. *H. indicus* is a potent plant utilized for both Ayurvedic and modern formulation. Various reported studies on the *H. indicus* are available to confirm its traditional applications. The roots of *H. indicus* are known to be rich in aromatic aldehydes and their derivatives. This medicinal plant is most commonly used in all traditional systems of medicine like Ayurveda, Siddha, Unani and folk system. *H. indicus* is a rich source of alkaloids, steroids, terpenoids, flavonoids, saponins, phenolic compounds, tannins, insulin, lignin and cardiac glycosides. Reported studies have revealed various pharmacological activities like anti-inflammatory, antimicrobial, antiulcer, antioxidant, anti-atherogenic, anti-carcinogenic, anti-leprotic, etc. In the present time *H. indicus* is in great demand due to which it is becoming an endangered species. Proper standardization is therefore required to extract the maximum benefit from this valuable plant.

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