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Review of a Rare Ashtavarga Plant: Jeevaka Crepidium Acuminatum D. Don Szlach

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Abstract

Jeevaka identified as *Crepidium acuminatum* (D. Don) Szlach. is a very important Ayurvedic drug originating in Himalayan region. Its pseudobulb is usedethno medicinally as tonic and aphrodisiac in Indian, Chinese etc. traditional medicine. In Ayurveda, it is used as a rejuvenative, spermatogenic and strength promoting drug and used in various important formulation. Due to its high demand it has become rare drug now a day; hence substituted and adulterated with various other drugs. Tissue culture studies using leaf, pseudo bulb and seeds are successful in this plant. Various studies like physico-chemical, phytochemical, have been conducted regarding the wild, cultivated and marketed samples. These results have shownsignificant differences in them. The major component found was 3'-O-Methylbatatasin III. It has been shown a good antioxidant and anti-microbial, analgesic and inflammatory activity. Also the drug was found non-toxic in animal studies.

Keywords: Jeevaka; Crepidium acuminatum; Ashtavarga; Ayurveda.

INTRODUCTION

Ayurveda, the medicinal plants have been given special importance since ancient times. These medicinal plants have been classified into various groups. Among those various groups, one of the important groups is Ashtavarga. According to Acharya Sharangadhara, Ashtavarga means group of eight plants viz. Meda [*Polygonatum verticillatum* (Linn.) Allioni], Mahameda (*Polygonatum cirrhifolium* Wall.), Kakoli (*Roscoea purpurea Smith*), Kshirakakoli (*Lilium polyphyllum* D.Don), Jeevaka [*Crepidium acuminatum* (D.Don) Szlach.], Rishbhaka [*Malaxis muscifera* (Lindl) Kuntze], Riddhi (*Habenaria intermedia* D.Don) and Vridddhi [*Habenaria edgeworthii* Hook.f.ex Collett]. Jeevaka consists of dried and fresh pseudo-bulb of *Malaxis acuminata* D. Don syn. *Microstylis wallichii* Lindl.[1] Its accepted name at present is *Crepidium acuminatum* (D.Don) Szlach. It belongs to the family orchidaceae.[2] The term Crepidium is derived from the Latin word crepida meaning boot, sandal, shoe or base possibly referring to the shape of the labellum.[3] The term acuminatum is derived from the Latin word acuminatus meaning tapering to a narrow point in reference to the leaf apex.[4]

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Regional and Ayurvedic names

The regional names of *Crepidium acuminatum* (D. Don) Szlach are Jeevaka in Hindi and Kannada, Jeevakam in Tamil and Malayalam and Jeevakamu in Telugu.[5] Gachno and Govindamaala in Nepali.[6] In Uttarakhand, it is known as Hari-musali and Jhatbhak.[7] Its bulb is used for bronchitis, as a tonic and is purgative.[8] Some of the important names in Ayurvedic literatures are hrasvanga, kurchasheersha, madhura, chirajivi, pranada etc.[9]

Distribution

It is distributed in India, Nepal, China, Thailand, Myanmar, Vietnam, Malaysia, Sumatra, Java and the Philippines.[10] It is distributed in Western, central, Eastern Nepal at the height of 4000-3100m and in West Himalaya, East Himalaya, Tibetean plateau, Assam burma, East Asia, South-east Asia and Australia.[11] In Uttarakhand it is distributed in Almora (Dunagiri, Pandavkholi, Kausani, Chaubatia, Jageshwar, Bageshwer (Kotmunya. Chaukri, Khati), Champawat (Lohaghat, Devidhura, Khetikhan, Banlekh), Nainital (Kilburry, Bhowali, Ramgarh, Salyura, Bhatrojkhan) and Pithoragarh (Lilam, Thal, Munsyari, Berinag, Didihat).[12] The distribution in Mussoorie is Camels back Cemetry, Near Mossy Falls and above toll gate.[13] It is generally found in Shady moist slopes and under the *canopy of Quercus leucotrichophora* and *Cedrus deodara* tree. In some other places, it was found under the canopy of *Myrica esculenta* and *Rhododendron arboreum* with *Quercus leucotrichophora* and *Cedrus deodara*. Dominant associates of *Malaxis acuminata* was found to be *Roscoea procera, Thalictrum foliolosum, Valeriana wallichii, Rumexnepalensis* and *Oxaliscorniculata*. Other dominant associates of the species were found to be *Galingsogaparviflora, Asparaguscurillus, Potentillafulgense* and *Polygonum* sp.[14] The IUCN status of this plant has been given as rare.[15]

Morphology

It is a terrestrial, lithophytic orchid, 14-30cm tall with yellow tinged with red-purple or pink-purple flower. The flowering and fruiting occurs in May-July. Its chromosome number (2n) is 30, 36, and 42.[16] Cytological observation of *Malaxis acuminata* D.Don showed twenty one rather small bivalents were counted at diakinesis. Many of them showed precocious disjunction. The meiotic course was found normal and the pollen grains formed soft pollinia.[17]

Ethno botanical uses

Ethno botanically, it has been used as a useful tonic, for tuberculosis, for enhancing formation of sperms, aphrodisiac and in seminal weakness.[18] A survey study regarding traditional use of *Malaxis acuminata* in Uttarakhand also showed that it was used as a tonic; to cure tuberculosis and enhance sperm production.[19] Similarly the bulb is also used for bronchitis, as a tonic and as a purgative.[20] The tribe Konda Reddis use the paste of the tuber of the plant of *Malaxis acuminata* (Jeevaka) externally in the case of insect bite. Also the tuber crushed with half the quantity of jaggery, mixed in castor oil applied externally for cattle with rheumatism is used by Koya Doras of Khamman District in South India.[21]

Ayurvedic Properties and Actions

According to Ayurveda it has guru guna (heavy in property), madhura rasa (sweet in taste), sheeta veerya (cold in potency) and madhura vipaka (post-digestive taste).[22] It is shukrala (spermatogenic), balya (strength promoting), kshayahara (alleviating consumption), karshyahara (alleviating emaciation), rakta dosahara (alleviating blood diseases) and dahahara (alleviating burning sensation).[23] The important formulation of Jeevaka as mentioned in various ayurvedic text are Brahma rasayana, Chvayanprasha, chandanadi taila, amritaprasha ghrita, Bala taila, Phala ghrita, Sudarshana choorna, Shatavari taila, Mahamasha taila, Dashmoolarishta, Lohasava, etc.[24] It has been indicated for external and internal use. The useful part is the pseubobulb. Its pseudobulb is used in ayurvedic formulation in dried and fresh form.

Pharmacognostic Studies

The fresh pseubobulbs are conical, fleshy, light green and covered with smooth, translucent, papery, with membranous covering and is mucilaginous. It is slightly bitter and astringent in taste. The dried pseudo bulbs are conical, translucent, and reddish-brown covered with sheathing leaves. The fracture is hard, coarsely granulated with irregular margin and white spots and is slightly mucilaginous in taste.

MICROSCOPIC STUDIES

Plant Anatomy

Leaf Anatomy

The leaf constants found in the plant *Microstylis wallichii* Lindl were Palisade ratio was 0.84+0.03,

the type of stomata was anomocytic, the size of stomata: 0.036 + 0.0005mm*0.03 + 0.0006mm, the stomatal index was 8.43 + 0.80 and the stomatal number was 70.34 + 2.28.[1] The leaf tissue stained with auramine O showed the presence of rod shaped bacterial colonies which the authors pointed out that the most probable species would be that of Corynebacterium.[26]

Root Anatomy

The *Malaxis acuminata* collected from western ghats showed that there was mycorrhizal colonization in the roots and rhizome restricted mostly to the inner cortical zone/ground tissue. The transverse section of root and rhizome revealed that there were one or more fungal hyphae entering the roots or rhizome through the root hairs or the epidermal cells. The mycorrhizal colonization was found low in the rhizome.[27]

Transverse section of Pseudobulb/Tuber

The T.S. of tuber showed barrel shaped epidermal cells with cuticle, large parenchymatous cells towards epidermis, scattered vascular bundles, phloem encircled by xylem and numerous mucilage canals.[28]

Powder Analysis of the Pseudobulb

The powder microscopic studies reveal the presence of ovalor irregularly arranged parenchymatous tissue, mucilage cells, acicular raphides and acicular crystals of calcium oxalate.[29]

Physico-chemical Analysis

The physico chemical analysis revealed that the moisture content to be 36.49+1.18; total ash 6.25+0.50; Acid insoluble ash to be 3+0.03; Water soluble ash to be 4+0.43; volatile oil 0.54+0.28; swelling index 1.92+0.14 and foaming index more than 1000. Similarly, in the cold percolation method, the extractive values in Petroleum Extract (40-60%), Ether extract (95%) and water to be 6.25+0.4, 4.75+0.4, 11.25+0.9 and in Soxhlet graded extraction method to be 6.25+0.4, 4.75+0.4, 11.25+0.9 respectively.[30]

Thin Layer Chromatography

The TLC of the methanolic extract on precoated silica gel G using toulene and ethyl acetate after derivatization showed the retention factor to be 0.12 (orange), 0.18 (purple), 0.29 (grey), 0.38 (orange) and 0.59 (brown)[31] and the retention factor in n-hexane, chloroform, acetone, and acetic acid with the standard 3'-O-methylbastatin III to be 0.26 (brown), 0.32 (pink), 0.41 (blue), 0.56 (orange), 0.71 (blue), 0.86 (purple) and 0.95 (purple).

Densitometry Analysis

The major component in Crepidium acuminatum (D. Don) Szlach. densitometric analysis for 3'-O-Methylbatatasin III was found to be 0.018 to 0.036 percent in nHexane, chloroform, acetone and acetic acid solvent system.[32]

Phytoconstituents

The chemical constituents mentioned are Beta Sitosterol, ceryl alcohol, glucose, rhamnose and choline[33]; limonene, eugenol, citronellal, 1,8-cineole, piperitone and p-cymene in oil.[34] Eugenol, Caryophyllene, Humulene, Phenol, 2,4 bis (1,1 dimethylethyl), Caryophylleneoxide, 2,5 Octadecadiynoic acid, methyl ester were the essential oils idenfied from Dichloromethane extracts of pseudobulbs of Crepidium acuminatum.[35] Lohani *et al*. (2013) analysed the chemical composition and found the major constituents were calcium, potassium and magnesium in metals whereas in fatty acids Linoleic acid and Alpha Linolenic acid were the major one. Other isolated components were Terpenoids, Alpha-Tocopherol and Gamma-Tocopherol.[36]

Trade Price

The trade price of *Malaxis acuminata* D. Don syn. Microstylis wallichii Hook. To be Rs. 80 per kilogram in 1998.[37] And the price has hiked to Rs. 400 per kilogram.[38]

Substitutes and Adulterants

The Astavarga plants including Jeevaka are in high demand and are exported at a very high price. These are used in traditional folk, Chinese and Ayurvedic medical systems. The change in vegetation, new crop introduction in the hill areas, habit fragmentation process, occupation, spreading of invasive species, and plantation of timber trees, anthropogenic inferences, manmade fire and cattle grazing are the important cause of the degradation of these plants.[39] Due to their high demand and rare condition, they are often adulterated and substituted. The substitute of Jeevakain Ayurvedic texts has been mentioned as vidari identified botanically as *Pueraria tuberosa* (Willd.) DC. in Gunaratnamala[40], Bhavaprakash nighantu[41] and Yogratnakar.[42] Other substitutes are Guduchi

[*Tinospora cordifolia* (Willd.) Miers.], Safed behman (*Centaurea behen* Linn.)[43] and *Liparis rostrata*.[44] The research study about the substitution of *Malaxis acuminata* D.Don with *Pueraria tuberosa* showed thatthe basis of substitution was neither based on pharmacological actions nor on Ayurvedic philosophy of drug actions.[45]

RECENT RESEARCH STUDIES

Antioxidant Study

The Butanol extract of *Malaxis acuminata* (Jeevaka) on free radical scavenging capacity on DPPH radical, determination of Reduction Capability by Fe3+-Fe2+ Transformation and determination of Hydrogen Peroxide Scavenging Activity showed that the extract exhibited an antioxidant activity in comparison to the standard compounds.[46] Similarly, the antioxidant activity of Pseudobulbs (air dried) of *Malaxis acuminata* sequentially extracted with petroleum ether (60-80 degree Celsius), chloroform and methanol at boiling temperature with the methods 1, 1-diphenyl-2-picryl hydrazyl (DPPH) radical scavenging activity, Reduction capability by Fe3+-Fe2+ Transformation method and Hydrogen peroxide scavenging method showed that it had a good antioxidant activity in relation to the standard compounds.[47]

Anti-microbial Studies

The ethanolic and methanolic extracts of specifically the tuber portion of the plant was found to be highly active against Human pathogen, *Staphylococcus aureus* and *Pseudomonas aeruginosa* through Susceptibility Test by Agar Well Diffusion Method.[48] Similarly, the hexane, chloroform, ethyl acetate, ethanol and aqueous extracts of *Crepidium acuminatumpseudo* bulb extracts showed significant zone of inhibition against "Gram positive" bacteria. The bacteria were *Staphylococcus aureus* MTCC 87, *Bacillus subtilis* MTCC 121 and Gram negative bacteria *Pseudomonas aeruginosa* MTCC424 and *Escheria coli* MTCC 40. The study also showed that the maximum zone of Inhibition was observed in chloroform extract and least in aqueous extracts.[49]

Analgesic and Anti-inflammatory Properties

The plant *Microstylis wallichii* (50-200mg/kg) caused a dose dependent inhibition of swelling caused by carrageenin significantly as compared to phenyl butazone. In cotton pellet induced granuloma test, the plant significantly decreased the granuloma dry weight which was comparable to the reference compound phenyl butazone. Similarly, the ethanolic extract of the plant caused a dose dependent inhibition on the writhing response as induced by acetic acid in comparison to phenyl butazone. Also, the dose 20-200mg/kg per oral showed significant increase in the pain threshold in force induced pain. Also the plant was not found to be toxic at the dose range of 2000mg/kg per oral.[50]

Tissue culture Studies

Tissue culture study of *Malaxis acuminata* D.Don showed that the pseudobulb explants from older ones (>0.5cm) remained recalcitrant to regeneration whereas relatively young (<0.5 cm in length) pseudobulb explants responded positively to selected combinations in the nutrient mixof 6 benzyl aminopurine and alpha naphthalene acetic acid individually favoured shoot bud mediated regeneration whereas their combination initiated PLB (protocorm like body to plantlet) mediated regeneration.[51] Other tissue culture studies using pseudo bulbs of *Malaxis acuminata* D.Don as explants showed that 2:0.5mg per litre of BA (6 benzyl aminopurine): IBA (Indole-3-butyric acid) and 2mg per litre of NAA (naphthalene acetic acid) concentration in Murashige and Skoog media yielded maximum root and shoot induction.[52]

Tissue culture studies of *Malaxis acuminata* D.Don using foam as an alternative to agar found that when the foam was used as substrata for tissue culture as an alternative to agar, the production cost reduced substantially. So, for these types of Invitro studies, foam also can be used as an alternative at cheaper cost.[53] The *Invitro* study of immature seeds of *Malaxis acuminata* D.Don was carried. The research showed that the asymbiotic germination of immature seeds could be carried on MS medium containing sucrose (3% w/v) and alpha naphthalene acetic acid (NAA; 4 micro meter under diffused condition of light 20 micro mol per metre square per second). Around 85 percent germinated into protocorm like bodies and differentiated into young plantlets.[54]

Propagation

The seed of the plant *Malaxis acuminata* D.Don is very minute and simple with little food reserve hence the propagation with seeds is difficult.[55] Similarly, the rostellum in flower acts as a physical barrier along with heavy rainfall and spiders as predators due to which this plant has a very low fruit set.[56] The propagation of the plant *Malaxis wallichii* was carried in Chakrata, Dhanolti and Mussoorie region. The study and assessment in four years showed that the propagation through whole

pseudobulb, middle portion of pseudobulb and tip portion of pseudobulb was more sucessful than the propagation through seeds and propogation through the basal portion of pseudobulb. Also, the propagation in Chakrata and Mussoorie was found better than Dhanaulti.[57]

Differences in Cultivated and Marketed Samples

The marketed and self-collected samples showed differences in alkaloids and flavonoides, foaming index, ash value and extractable matter in various samples.[58,59]

CONCLUSION AND DISCUSSION

Hence, the plant *Crepidium acuminatum* (D.Don) Szlach. which is one of the Ashtavarga plant is a very important plant used in Indian and Chinese systems of medicine. It used as a tonic and rejuvenator. Due to very important uses, high price and low availability it is in high demand it is now a rare drug. Hence it is frequently substituted and adulterated. The substitute mentioned in Ayurveda, Vidari [*Pueraria tuberosa* (Willd.) DC.] also does not match the properties both on the basis of Ayurveda and modern drug parameters.

Due to very important therapeutic uses and high demand in industry various propagation studies have been carried of which the propagation with pseudobulb was successful and it can be used for further propagation. Tissue culture have been carried out and were successful with seeds, pseudobulb and leaf. It is nontoxic in animals and has shown potent antioxidant, anti-inflammatory and anti-microbial activity. Hence this plant should be protected and propagated for wellbeing of mankind.

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