

THERAPEUTIC AND NEUTRACEUTICAL POTENTIAL OF ASPARAGUS ADSCENDENS ROXB. (SHWET MUSHALI): REVIEW STUDY

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ABSTRACT

Asparagus adscendens Roxb. is an important drug used in Indian system of Medicine. It is sub-erect or curved prickly shrub with straight spines and white tuberous roots. In *Ayurveda*, some scholars have considered it as botanical source of the classical drug *Shwet Mushali*. It is also known as *Ujli Mushali*, *Satamuli*, *Hazarmuli* and *Safed Mushali*. Its white, hairy and mucilaginous tubers are utilized as vegetable. Its roots are used for the treatment of many disease conditions like dysuria (*Mutrakrichchhra*), urinary problems (*Prameha*), general debility (*Daurbalya*), impotence (*Klaivya*),

oligospermia (*Shukrakshaya*). It has cooling and demulcent properties and potentially efficient to control the symptoms of AIDS. Recent studies have supported its use in nervous disorder, infectious diseases and cancer. The present paper is an attempt to comprehensively review classical and contemporary texts regarding general information, pharmacological properties, therapeutic indications of the drug and relevant studies altogether.

KEYWORDS: *Asparagus adscendens*, *Shwet Mushali*, Pharmacological properties.

INTRODUCTION

India is one of the countries having most diverse biological wealth. Since time immemorial, plants have been used for various human needs including medicine. Ancient Indian Literature incorporates a broad definition of medicinal plants and considers all plants to be potential sources of medicinal substances. Local Health Traditions and Home Remedies constitute an important part of primary healthcare in India. Plant has been reported to be used

in the management of large number of disease conditions and also for conservation of health.

A. adscendens belongs to Family Asparagaceae (previously Liliaceae). The genera *Asparagus* consists of 350 species throughout the world out of which about 22 grow wild or are cultivated in India. Out of several species grown in India, *A. racemosus*, *A. gonoclades* and *A. adscendens* are most commonly used in traditional and Indigenous medicine practices.^[1] Word *Asparagus* is derived from a Greek word 'Aspharagos' which in turn is originated from the Persian word 'Asparag', meaning "sprout" or "shoot". *A. adscendens* is a suberect prickly shrub bearing white tuberous roots. It is commonly known as *Shwet Mushali* or *shatavar bhed*. Thorough study of ancient *Ayurvedic* literature reveals that it has several important therapeutic properties and indications which have also been proved experimentally by recent studies.

METHODOLOGY

A thorough review of literature starting from *Vedic* texts, classical texts of *Ayurveda* and contemporary texts including research papers published in various journals and periodicals was undertaken in a phased manner as a part of study "An explorative study to determine ideal post harvest handling technique for *Asparagus adscendens* Roxb. (*Shwet Mushali*)".

Observations

Asparagus adscendens vis-à-vis Sweta Mushali^[2]

Thorough exploration of texts reveals that the term "*Mushali*" has not been used in *Vedic* text. Although a drug named *Sanskanda* has been mentioned in *Atharvaveda*,^[3] which seems similar to *Shwet Mushali* on basis of properties and morphology. Its correlation with *Shwet Mushali* may be considered for analysis. In *Brihatrayee*, *Acharya Charak* has mentioned a drug named "*Talmuli*" for Smoking (*Dhumpan*) in the treatment of cough (*Kasaroga*) (CS.Ci.8.75)^[4] which was later established as synonym for *Krishna Mushali* with *Curculigo orchoides* Gaertn. of family *Amaryllidaceae* as its botanical source. *Acharya Sushruta* has mentioned two drugs namely *Talmuli* and *Talpatriti*^[5] used in various preparations for external use and considered to be synonyms of *Krishna Mushali*. Drug (Term) *Mushali* has been used for the first time in *Ashtang Hridaya* for external application (pigmentation disorders like *Nilika* and *Vyanga*) and internal administration as powder for treatment of Graveluria/ Crystaluria (*Mutra Sharkara*),^[6] Term *Mushali* has been interpreted by *Acharya Dalhana* as "मूषकपुच्छाकारशिखाः" which means its roots resemble with the tail of rat, and is considered to

be *Krishna Mushali*.

There is description of *Mushali* in *Shodhal Nighantu*⁷ with its two varieties namely *Shwet* and *Krishna Mushali* but some content is unavailable. In *Raj Nighantu*, two types of *Mushali* i.e. *Shwet* and *Apara (Krishna)* are clearly mentioned and *Krishna Mushali* has been said to be superior in properties as compared to *Shwet*.^[8] He has also mentioned the properties of *Mushali* as *Madhura Ras* (Sweet taste), *Sheeta Veerya* (Cold), *Vrishya* (Aphrodisiac), provides nutrition and strength, imparts *Pichchhilita* (Unctuousness) in the body, increases *Kapha dosha* and alleviates *Pitta dosha*. It is also very good to ease fatigue.

Presently, two varieties of *Mushali* are being used in practice in the name of *Shwet* and *Krishna Mushali*. There is a controversy regarding botanical source of *Shwet Mushali*. In Ayurvedic Pharmacopoeia of India, tubers of *Chlorophytum borivillianum* Santapau R.R. Fern of family Asparagaceae have been accepted as official drug for *Shwet Mushali*. Acharya P V Sharma has considered *Asparagus adscendens* and *Chlorophytum arundinaceum* Baker. as probable botanical sources for the classical drug *Shwet Mushali*.^[9] Various pharmaceutical companies are marketing powder of tubers of *A. adscendens* in the name of *Shwet Mushali churna*. Therefore, tubers of *C. borivillianum* are official drug for *Shwet Mushali* and the tubers of *A. adscendens* should be considered as its potential substitute.

Type	Botanical source	References
<i>Krishna Mushali</i>	<i>Curculigo orchioides</i> Gaertn.	1. Reviews on Indian medicinal plants (vol.8, pg 289) ^[10]
<i>Shwet mushali</i>	1. <i>Asparagus adscendens</i> Roxb.	1. Reviews on Indian medicinal plants (vol. 3 pg 212) ^[10] 2. Indian materia medica (vol. 1 page 309) ^[12] 3. Indigenous drugs of India (R.N. Chopra, 1958) ^[13] The wealth of India (vol. 3 page 482) ^[14] 5. Dravyaguna Vigyana vol. 2 (P.V. Sharma, 2001) ^[9]
	2. <i>Chlorophytum arundinaceum</i> Baker	1. Reviews on Indian medicinal plants (vol.6, page 87) ^[10]
	3. <i>Chlorophytum borivillianum</i>	1. Patil (2000) ^[11]
	4. <i>Chlorophytum tuberosum</i> Roxb. Baker	1. The database of Indian medicinal plants (vol. 6 page 90) ^[10]
	5. <i>Asparagus filicinus</i> Buch. Ham. Ex D. Don	1. Kirtikar and Basu Indian medicinal plants (vol. 4, pg 2498) ^[12]
	6. <i>Asparagus sarmentosus</i> L. Heyne.	1. Watt (1889) ^[15]

Geographical distribution

A. adscendens is widely distributed in the plains and sub-hilly areas of Punjab, foothills

regions of Pakistan and Kashmir, Afghanistan and in the Himalayas up to an altitude of 5300 feet.^[16] It grows wild in the forest of western Himalayas including regions of Himachal Pradesh, Punjab, Jammu and Kashmir, Uttar Pradesh, Bihar, West Bengal, Orissa, Madhya Pradesh, Gujarat, lower and foothills of Himalayas (Saran et al., 2020) and in the states of Gujarat, Madhya Pradesh and Maharashtra.^[17] It is found growing luxuriously in the forests of Pilibhit Tiger Reserve and Dudhwa Tiger Reserve, Uttar Pradesh.

Morphological features^[18]

A. adscendens is a prickly shrub. Stem is tall, sub-erect to erect, white in colour and branched. Branchlets are ascending, scribed and angled. Spines are 1-2 cm long and straight. Leaves are the form of modifications i.e. cladodes which are soft, filiform, slender and dense (in tufts of 15-20). Flowers are usually bisexual and small arranged in raceme inflorescence. Fruit is spherical and pulpy berry. From the main root, a tuft of white, bulbous and ovate roots (Tubers) emerge.

Cultivation

Though found growing luxuriously in forests of Pilibhit Tiger Reserve and Dudhwa Tiger Reserve, it is considered endangered in its natural habitat due to over harvesting. It becomes necessary to cultivate it commercially to meet the demand. The plant preferably grows in light to medium soils but can also be grown in sandy, sandy loam and silt type of soils. The ideal soil for its cultivation is considered to be the black, deep, loose and well-drained fertile sandy loam. Soil with a pH neutral to slightly alkaline (6–7.5) is optimum but it can be sustained under cultivated up to pH 8, organic carbon 0.79 % and phosphorus 7.3 (kg per acre). Formation of roots has even been reported in gravelly and rock soils depth of 100 cm.^[19,20] It is grown in exposed or even shaded land, but very high moisture levels result in degradation of roots. *A. adscendens* is being cultivated in Districts of Uttar Pradesh viz. Pilibhit, Kheri, Lakhimpur, Shahjahanpur, Bareilly, which forms Terai Arc Landscape, in the upper Gangetic Plain Bio-geographic Province. The cultivation practice of this plant includes following method.^[21]

Propagation material - Propagation is done with seeds and crown rhizomes. Seeds are preferred over rhizomes because of higher germination rate and increased productivity. In the month of March to May, the seeds get mature and their colour changes from red to black. These are collected at this time and preserved to be used for planting.

Plantation

Land preparation – The land is preferably given a deep disc plough, followed by harrowing and leveling. The field is divided into plots, keeping on irrigation channel in between two rows of the plots. Ridges and furrows are made 45 cm apart within the plots.

Fertilizer application – About 10 tonnes per hectare of well-decomposed Farmyard manure is properly mixed to the soil one month prior to transplanting. A further dose of 60 Kg Nitrogen, 40 Kg Phosphate and 40 Kg Potassium per hectare is added for optimum growth and higher yield of the tubers. This is done as, one third of the total dose of Nitrogen and entire dose of Phosphate and Potassium is placed 10-12 cm deep in the rows before transplanting.

Transplantation - The seedlings that were sown in nursery field become ready to be transplanted in 45 days. The transplantation is done in the month of July (onset of Monsoon). As, mentioned above ridges and furrows are made 45 cm apart and the seedlings are transplanted on the ridges, maintaining a plant to plant distance of 15 cm. The ridge method is considered superior to the flat land method in terms of productivity. Using this method, around 150,000 seedlings can be transplanted per hectare.

Harvesting and Post harvest handling

The fasciculate tuberous roots may be harvested from six months of transplanting and up to a period of fifteen years.^[22,23] At the time of 18 months from transplantation, the aerial part of the plant begins to turn yellowish in colour, which is considered as the maturity parameter of the plant (Maturity Index). Winter season (from November to December) is the best time for harvesting of the tubers. The crop when harvested at 12 months, yields about 4-5 tonnes of tubers per hectare. Harvesting if done at 20 months, yields about 6 tones/hectare tubers along with 35 kg/hectare of seeds. Seeds are not obtained from 12 month old crop.

The harvested tubers are firstly washed thoroughly with running water and allowed to dry in open sun for one to two days. The tuberous roots are then kept in luke warm water for one hour. This helps to soften the outer covering of the roots, facilitating its removal. The harvested roots are then peeled manually by pulling their outer thin covering. The peeled tubers are then kept in shade for around four to five hours, followed by further sun-drying. The roots should be completely dried before storage. It is considered dry if it breaks with a cracking sound. These dried tubers are then packed in cardboard boxes and kept for storage.

It has been also observed, that conventionally the tubers are boiled before peeling. This serves two purposes i.e. outer covering removal becomes easy and the tubers turn yellow in colour so become cosmetically superior and fetch higher market rates as compared to non-boiled tubers. The tubers in the size of 5-15 cm x 1-2 cm are marketed as 'A' grade variety.

Nutritional profile

Root powder of *A. adscendens* is rich in carbohydrates (30.65 mg per gram) and proteins (0.76 mg per gram) on dry weight basis.^[19] It also contains dietary fiber and vitamins (A, C, B1, B2, E and folic acid), minerals (Ca, Mg and P). Therefore, it is frequently used for preparation of health tonics. Primarily roots contain steroidal saponins exhibiting variety of properties and thus find numerous pharmacological applications.^[22,25]

Phytochemical analysis

Asparagus adscendens has been experimented and evaluated for its phytochemical profile. A variety of active phytoconstituents i.e. secondary metabolites have been reported from it. In general, saponins represent the major portion of the compounds present in the plant.^[19] Important phytochemicals extracted out of the drug are tabulated as under:-

S. No.	Part of the Plant	Class of compounds	Name of the compound
1.	Fruits ^[27] (methanolic extract)	Phytosterol	Beta-sitosterol
		Stigmastanes (Plant sterols)	Beta-D-glucoside
		Spirostanol glycoside (saponins)	Asparanin A and B
		Furostanol glycoside (saponins)	Asparoside A and B
		Saponin	Diosgenin ^[30] Sarasapogenin ^[30]
2.	Roots ²⁸	Spirostanol glycoside (saponins)	Asparanin C and D
		Saturated hydrocarbons	Tritriacontane ^[30] Tetratriacontane ^[30]
		Fatty acid (Long chain)	Stearic acid ^[30]
		Saponins	Sapogenin A ^[30] Sarasapogenin ^[30]
		Fatty acid methyl ester	Methyl pentacosanoate ^[30]
		Fatty acid methyl ester	Methyl palmitate ^[30] Palmitic acid ^[30]
		Plant sterols	Stigmasterol ^[30]
		Furostanol glycoside	Asparoside C and D
		Oligofurostanoides	Adscendoside A and B
3.	Leaves ^[29]	Spirostanoides	Adscendin A and B

Classical uses

Mushali has been used in number of medicinal and nutraceutical formulations mentioned in various *Chikitsa grantha* of *Ayurveda*. It has been mentioned as a content in treatment of *Arsha roga* (V.S.21.256)^[43] (BP.Ci.5.74)^[44] (Bh.R.9.66),^[45] in *Khandakadya lauha* for *Raktapitta chikitsa* (V.S.45.193) (BP.Ci.9.75) (Bh.R.13.80); in *Manadi vati* and *Udaradi lauha* for *Udara roga chikitsa* (V.S.83.210); as Bhawna dravya in *Sangrah Grahani kapat rasa* (Bh.R. 8.270); it is very potent medicine for rejuvenating therapy (*Rasayan karma*) for instance as a content of *Lauha rasayan* (V.S.83.455), *Paniya bhakta gutika* (*Shastam*) (V.S.83.210), *Shatavari yog* (BP.Ci.72.11), *Mushali putapaka* (Bh.R.2.146), *Neelkantha rasa* (Bh.R.73.69); in *Vrihad Varunadi Kwath* for *Ashmari chikitsa* (Bh.R.36.18); in *Mehantak rasa* for *Prameha roga chikitsa* (Bh.R.37.153); in *Sarvatobhadra rasa* for *Amlapitta chikitsa* (Bh.R.56.85); in *Saubhagya Shunthi paka* (*Vrihad*) for puerperal diseases (*Sutika roga*) (Bh.R.69.39); the drug is said to be very potent aphrodisiac (*Vajikaran*) and used as *Moola churna* (Sh.P.4.16),^[46] (Sh.M.12.262),^[46] in *Gokshuradi modak* (BP.Ci.72.25) (Bh.R.74.267) and *Kameshwar modak* (BP.Ci.72.39) (Bh.R.74.186); in *Madan Kamdev rasa* for treatment of Erectile dysfunction (*Dhwajbhanga*) (Bh.R.92.20)(Sh.M.12.262).

Ethno medicinal uses

1. Its roots and tubers possess cooling and demulcent properties and utilized as vegetable.^[47,48]
2. Root powder is used as tonic; in diarrhea, dysentery and general debility in Rohilkhand and other parts of India.^[49]
3. The leaves of *musali* are used for the treatment of dysentery in Punjab, Haryana, Rajasthan and Gujarat. The roots are used for preparing veterinary medicines in Morni and Kalesar district of Haryana.^[50]
4. Decoction made of whole plant is used for dysuria.^[51]
5. Its leaves in the form of powder and decoction are used as expectorant.^[52]
6. Powder of the stem is used for its aphrodisiac properties.^[53]
7. The root powder is used in dyspepsia and anemia.^[54]
8. The powder of root taken with milk is very useful as a tonic in general debility.^[55]
9. Its root powder has been used as an effective medicine to control premature ejaculation.^[56]
10. Root is utilized as a cooling agent for treatment of mastitis in cattle.^[57]
11. Root powder is used as galactagogue (Promote milk production and secretion) in case of lack of lactation.^[58]

12. Root paste is used as an antidote to snake and scorpion bite.^[59]

13. In treatment of diarrhea, dysentery and general debility.^[60]

Dose: Powder – 3 to 6 grams; Paste – 1 - 3 grams (Oral) and Q.S. for Local application; Decoction –40-60 ml.

Pharmacological activities reported

- 1. Antifertility activity:** Powder of seeds mixed with equal amount of gum acacia was given to albino rats at a dose of 175 mg/kg orally once a day during the mating period. It was found to exhibit 28% abortifacient activity.^[31]
- 2. Antimicrobial activity:** Steroidal saponins isolated from the extract of root showed antimicrobial activity against a number of pathogenic bacteria namely *Bacillus anthracis*, moderate activity against *Proteus vulgaris*, *Staphylococcus aureus*, *Streptococcus agalactiae*, *Aspergillus niger* and *flavus*. Slight activity against *Pseudomonas aeruginosa*, *Salmonella*, *Corynebacterium pyrogens*, *Hemophilus influenza*.^[32,33]
- 3. Antifilarial activity:** Aqueous as well as the alcoholic extracts of the root showed antifilarial activity in in-vitro studies against *Setaria cervi*. It inhibited the spontaneous motility of whole worm and the nerve/ muscle. The LC50 and LC90 were 8 and 16 microgram/mL for aqueous while 3 and 12 microgram/mL for alcoholic extracts respectively.^[34]
- 4. Anthelmintic activity:** The steroidal saponins Asparanin A and B from the fruits showed nematicidal activity against *Meloidogyne incognita*. It affected the larval mobility.^[35]
- 5. Chemopreventive activity:** Test doses of 2.4 and 6% (w/v) of root extract showed effective prevention of chemically induced cancer of the skin and fore-stomach in mice. Significant reduction in the incidence of tumor was also reported.^[36]
- 6. Preliminary test:** The screening of ethanolic extract of the plants (50%) was found to be devoid of antifertility, hypoglycemic, anticancer and diuretic activities in mice, but showed to have potential effects on Cardio Vascular and Central Nervous Systems.^[37,38,39]
- 7. Antifungal activity:** methanolic extracts of root and leaves (95% w/w) exhibited promising antifungal activity against *Aspergillus flavus*, *A. terreus*, *A. niger* and *Alternaria spp.*^[40]

- 8. Hypoglycemic activity:** Decoction of root in strength of 25g/L was used for in-vitro study to determine insulin secretion in rat pancreatic beta cells and rat insulinoma RINm5F cells. Through this study, intracellular calcium concentration and membrane potential studies; Adipocyte differentiation and glucose uptake study; starch digestion study were also conducted. Concentration-dependant stimulatory effect on insulin secretion was observed. It caused depolarization of the beta cell producing biphasic increase in Calcium ions. Increased glucose uptake by adipocytes. Aqueous extract resulted in 21% decrease in glucose liberated from starch on incubation.^[41]
- 9. Nootropic activity:** Conyopododiol, isolated from the chloroform fraction of methanolic extract of *adscendens* exhibited significant inhibition of both acetylcholine esterase and butyryl choline esterase and hence it is used as nervine tonic and memory enhancer.^[42]

CONCLUSION

Asparagus adscendens is a rare and endangered Shrub. It is one of the important sources for the classical drug *Shwet Mushali*. It has been used to treat a variety of disease conditions and also as a potent health tonic by traditional healers and *Ayurvedic* scholars. It is known to possess wonderful aphrodisiac properties. Saponins are the major phytochemicals reported from the plant and contribute to its therapeutic efficacy. Knowing its efficacy and importance, this plant should be conserved in natural habitat and cultivated at commercial scale.

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