

A Broad Review on Shatavari (*Asparagus racemosus*): Queen of All Herbs

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Abstract

Asparagus racemosus Wild. (fam. Asparagaceae [1]) also named as shatavari is used in Indian Ayurveda over centuries. It is also called as "herb's queen" [2]. *A. racemosus* helps to balance vata and pitta, improve the reproductive and digestive health, helps in diabetes mellitus, reduce the stress levels, controls high cholesterol and triglyceride levels. It is widely used in infertility, cancer, depression, oedema, infection like bacterial or fungal, epilepsy, kidney disorders, chronic fevers, excessive heat, stomach ulcers and liver cancer, increases milk secretion in nursing mothers and regulates sexual behaviors. All the parts have pharmaceutical properties, but the stems, roots and leaves are mostly used as medicine. Its major constituents are steroidal saponins. Roots consist of Isoflavones, racemosol, polysaccharides, asparagamine, mucilage and, many vitamins A, B1, B2, C, E, Mg, P, Ca, Fe, and folic acid [3]. This article is to review the chemical constituents and pharmacological activities to understand how asparagus have potential to cure diseases.

Keywords: Asparagus; Asparagaceae; Pharmaceutical; Medicinal

Introduction

A. racemosus is used since Pre-vedic times and remarkably mentioned in our natural herbal system i.e. ayurvedic literatures. It grows 1-2 m long and its roots goes in gravelly, rocky soils high up in piedmont plains, at 1300-1400 m elevation [4]. Some of the medicinal properties of *A. racemosus* are antispasmodic, anti-allergic, anti-neoplastic activities, anti-oxidant, anti-diabetic, anti-malarial, hepatoprotective, enhance immune responses, anti-arthritis, anti-inflammatory, anti-periodic, Anti-ulcerogenic action, immunomodulatory, antistress, Anti-diarrhoeal, Antidepressant, anti-leprotic, anti-abortifacient activity, antibacterial, antipyretic and analgesic. Saponins are mainly present in its roots, for example, shatavarin I-IV, the glycosides of sarsasapogenin [5]. It has secondary metabolites which includes steroids, alkaloids, dihydrophenanthrene derivatives, flavonoids, furan derivatives and essential oils (Tables 1 and 2).

Geographical Source: It is widely spread across the earth and found in tropical Africa, Australia, Sri Lanka and South of India, but India is highest producer of Shatavari. This plant is counted in one of the endangered species.

Cultivation and Morphology: Crops mainly require the tropical, hot and humid climate. Black soil is preferred for cultivation. Minimal irrigation is required. Harvesting can be started from 1.5-2 years till 10-15 years. *A. racemosus* plant usually blooms in June to July. Morphology of *A. racemosus* is:

Roots: 5-15 cm long, 2 cm thick, externally silvery white (ash color), internally white, longitudinal wrinkle upon drying, 18-24 layer

Table 1: Scientific classification [6].

Kingdom	Plantae
Clade	Angiosperms
Clade	Monocots
Order	Asparagales
Family	Asparagaceae
Subfamily	Asparagoideae
Genus	Asparagus
Species	<i>A. racemosus</i>

cortex, 42-47 middle tuberous root, turns brown on drying [7].

Seeds: Hard and brittle, black color.

Fruit: Small, round, globular, 3-lobed, purplish black pulpy berries, turn from raw green to ripened blackish purple.

Flower: Small and uniform in size, white flower having spikes with pink tinge, pollinated by bees, aromatic, unisexual.

Phytochemicals: *A. racemosus* consists of wide variety of chemicals in which major component is steroidal saponins along with alkaloids,

Table 2: Vernacular names.

Sanskrit	Satavari
Hindi	Satavari, Shatawar or Satmul
Bengali	Shatamuli
Marathi	Shatavari or Shatmul
Gujarati	Satawari
Telegu	Toala-gaddalu or Pili-gaddalu
Tamil	Shimaishadavari or Inli-chedi
Malayalam	Chatavali
Kannada	Majjigegadde or Aheruballi
Madhya Pradesh	Narbodh or atmooli
Kumaon	Kairuwa
Rajasthan	Norkanto or Satawar
Nepal	Kurilo

* Shatavari stands for "curer of a hundred diseases."

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flavonoids, dihydrophenanthrene derivatives, furan derivatives and some of the volatile components (Tables 3, 4 and Figure 1).

Pharmacological Activities

Galactagogue effect: Root extract of this plant in Ayurveda prescribe to increases milk secretion during lactation [17-20]. Tablets like Ricalax and lactare having *A. racemosus* shown to increase in milk and growth of mammary gland in females complaining about milk deficit during lactation. In other study, the alcoholic extract of roots at 250 mg/kg administered intramuscularly shown high yield and increase in mammary gland lobuloalveolar tissue in primed rats. This is due to promote action of released corticosteroids and increase in prolactin [20].

Antioxidant effect: In lab [12-21], the mitochondrial membrane of the rat liver shows the antioxidant effect induced by the free radical generated on exposure to gamma rays in plant extract of *A. racemosus*. GPX and GSH enzyme activity enhanced so protein oxidation and lipid peroxidation is inhibited.

Diuretic effect: Diuretic property highlighted by Ayurveda is proven in vitro by aqueous extract of roots having 3 dose vials 800 mg/kg, 1600mg/kg and 3200 mg/kg conducted on rats after acute toxicity

tests. Diuretic property by observed in extract at 3200 mg/Kg without any acute toxicity [21].

Antiparasitic and Antibacterial effect: Alcoholic extract of roots has antibacterial effect against *Staphylococcus aureus* and *Escherichia coli* whereas aqueous solution [22] does not have any impact. Fungitoxicity against three plant fungi viz., *Helminthosporium sativum* (60.7%) [23] *Colletotrichum falcatum* (58.2) and *Fusarium oxysporum* (60.7%) is shown by root juice. The methanol fraction of the leaves using the disc diffusion test at a concentration of 4000 and 5000 ppm [24] inhibits *Proteus vulgaris*. Antibacterial activity against *Staphylococcus* is shown by the fresh plant juice. The extract of the plant showed moderate toxicity against *Rhizoctonia solanil* [25].

Antilithiatic effect: *A. racemosus* ethanolic extract reduce oxalate, calcium and phosphate ions in urine which are the main cause of renal stone formation. Christina et al studied antilithiatic effect of *A. racemosus* Wild on ethylene glycol induced lithiasis in male albino Wister rats [26].

Adaptogenic and anti-ulcer activity: *A. racemosus* induce a property to enhance the ability to changes according to environment. It belongs to rasayana herbs hence increase the cellular immunity. The extract of *A. racemosus* when compared with the Ranitidine

Table 3: Chemical constituents.

Parts	Chemical constituents [8-15]
Roots	Rutin, asparagan, Asparagamine A, 9,10- dihydro 1, 5 methoxy- Quercetin3 glucouronides, 8-methyl-2, 7- phenenthrenediol, Racemofuron, ncoumertans, Shatavarin V. Shatavarin I-(steroid glycosides), Immunoside, Sitosterol, Shatavari, Secoisolaricresinol, diosgenin, Racemosol, 4- trihydro isoflavine 7-O-beta-D-glucopyranoside, Sterols, Alkaloid, Tannins, carbohydrates, Flavonoids, isoflavones, coumestans, prenylated. Lactones, Amino acids and rutin, Undecanyl cellanoate, 4,6- dihydroxy-2-O (2- hydroxyl isobutyl) benzaldehyde
Flowers	Rutin, Diosgenin, Quercetin, hyperoside
Fruits	Quercetin, rutin, Hyperoside, Racemoside A, B, & C
Leaves	5-hydroxy-3,6,4'-trimethoxy-7-O-β-D-glucopyranosyl-[1→4] -O-α-D-xylopyranoside, Quercetin-3-glucuronide
Shoot	Sarsasapogenin and kaempferol Thiophenes, thiazole, ketone, Undecanyl cetamoate, aldehyde, Gamma linoleinic acids

Table 4: Medicinal Effects of Plant parts.

Leaves	Cholinesterase, Antiparasitic
Shoots	Antiinflammatory, Antidiabetic and Diuretic
Whole Plant	Antimicrobial and Cytotoxic, Nephroprotective, Hepatoprotective
Aerial Parts	Urolithiasis, Hypolipemic, Antiasthmatic and Antifertility
Seeds	Antiparasitic

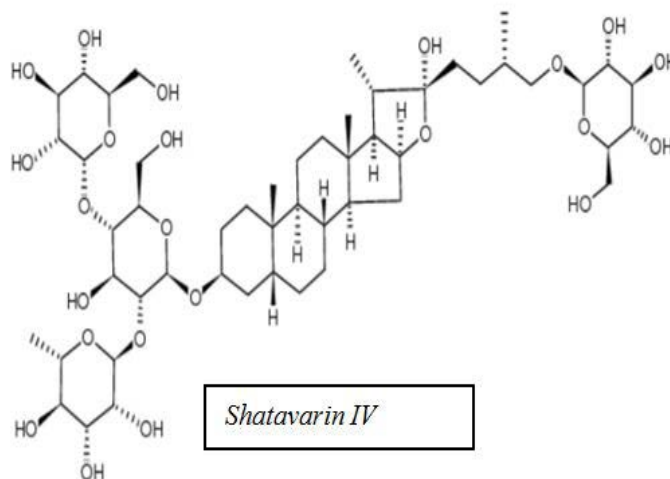


Figure 1: Compound Structure of Shatavarin IV [16].

then reduced gastric secretion, low ulcer patches and free acidity was observed. Satavari mandur, formulation of *A. racemosus* given in the dose of 1.5 g, twice daily for a month displayed noteworthy improvement in symptoms of peptic ulcer [27] and healing of peptic ulcers was endoscopically verified.

Antifertility: *A. racemosus* is known as female tonic in Ayurveda. It increases the libido, cure inflamed and dry tissues in sexual organs, ovulation and follicleogenesis enhancement, conception preparation of womb, miscarriages prevention. It also treats leucorrhoea and menorrhagia.

Cytotoxicity, analgesic and antidiarrheal activities: In acetic acid induced writhing in mice, the ethanol extract possess noticeable inhibition of writhing reflex 67.47% ($P < 0.01$) with 500 mg/kg body weight. The plant extract showed antidiarrheal activity in castor oil induced diarrhoea in mice. It increased mean latent period and decreased the frequency of defecation with number of stool count at dose of 250 and 500 mg/kg body weight, respectively comparable to the standard drug Loperamide at dose of 50 mg/kg body weight. Also, the brine shrimp lethality test showed significant cytotoxic activity of the plant extract (LC50: 10 µg/mL, LC90: 47.86 µg/mL) (Tables 5 and 6) [28].

Anti-cancer property: The protective effect of mammary cell carcinoma is exhibited by the root extract of the *A. racemosus*. The tumor cell death is inferred by the steroidal component of *A. racemosus* which is investigated for its apoptotic activities. In Vivo an experimental model of Ehrlich ascites carcinoma [29] tumor bearing mice was evaluated to check the anticancer activity of Shatavarins (shatavrin IV) and same has been evaluated by MTT assay using MSCF-7 (human breast cancer), A-498 (Human Kidney carcinoma) cell lines and HT-29 (human colon adenocarcinoma). The above experiments showed that the extracts are having potential anti-cancer activities (Table 7).

A. racemosus (Shatavari) ayurvedic indications: Shatavari also known as Shatapadi, Dveepika, Satamuli, Satavirya, Vari, Sukshmapatra, Indavari, Peevari, Madabhanjani, Bahusuta, Rushyaprokta, Narayani, Atirasa, Dveepishatru, and Urdhavakantaka.

Ayurveda's has mention shatavari in many medical remedies like Deepana, Pachana, Rochana, Anulomana, Vamana, Vayasthapana, Jvara, Kasahara, Shwasha, Amahara, Dahahara, Prameha, Trutahara, Mehahara, Rasayani, balya, gulmajit, hikkani-grahana, kantya, triptighno, hridaya, chakusya, garbhaprada, Vamanopaga, shonitasthapana, pandu, sangrahini, kustha, kamala, medhya, varnya,

Table 5: Biochemical activities [8-15].

Bio-activity	Procedure of Action
Anticarcinogen activity	Steroidal saponins used for apoptosis inducing study
Antidepressant activity	Roots methanolic extract is used
Antihepatotoxic potential	Alcoholic extract of root have antihepatotoxic properties
Cardiovascular activity	Alcoholic extract from its roots
Dyspepsia properties	Powder of dried root of <i>A. racemosus</i> . and the <i>A. racemosus</i> fresh root juice
Galactagogue properties	<i>A. racemosus</i> root extracts Ricalex tablets (Aphali pharmaceutical Ltd. Ahmednagar) lactare (TTK Pharma, Chennai)
Immunomodulant activity	Polysaccharide fraction is used
Neural Disorders activity	Extract potential examined against Kainic Acid (KA)- striatal neuronal damage and induced hippocampal
Respiratory action	Roots alcoholic extract at higher doses
Uterus properties	Roots extracts Ethyl acetate Acetone is used

Table 6: Trace Elements in *A. racemosus* [30].

Metal	Leaves (mg/mg)	Roots(mg/Kg)
Zinc	53.0 ± 0.2 to 165.0 ± 3.2	44.0 ± 0.2 to 148.0 ± 1.2
Lithium	28.0 ± 0.6 to 48.0 ± 1.6	18.0 ± 0.2 to 58.0 ± 3.8
Copper	15.0 ± 0.6 to 34.0 ± 0.5	14.0 ± 0.1 to 23.0 ± 0.3
Calcium	1346.0 ± 0.3 to 6153.0 ± 1.6	961.0 ± 0.6 to 2115.0 ± 3.2
Manganese	14.0 ± 0.4 to 84.0 ± 0.7	5.0 ± 1.4 to 62.0 ± 2.5
Potassium	5460.0 ± 0.2 to 10842.0 ± 2.5	2652.0 ± 0.4 to 13260.0 ± 3.5
Iron	505.0 ± 0.2 to 2040.0 ± 0.3	211.0 ± 0.5 to 1493.0 ± 0.2
Sodium	127.0 ± 0.6 to 745.0 ± 0.3	199.0 ± 0.5 to 490.0 ± 20
Cobalt	85.0 ± 0.3 to 88.0 ± 0.2	84.0 ± 0.3 to 122.0 ± 1.5

Table 7: Formulae Containing *A. racemosus*.

Drug	Content of <i>A. racemosus</i>	Medicinal property
Abana ® [31-34]	Each tablet has 10 mg Shatavari root extract	Hypertension, hyperlipidemic, Platelet aggregation inhibition, angina Adjuvant in cardiac risk factor
Diabecon ® [35-37]	Each tablet has 20 mg Shatavari root extract	Early retinopathy, Microalbuminuria, Monotherapy in non-insulin-dependent diabetes mellitus
Lukol ®	Each tablet has 40 mg Shatavari root extract	Leukorrhea, Malaise, Backache associated with leukorrhea and Pelvic inflammatory disease
Geriforte ®	Each tablet has 20 mg Shatavari root powder	Geriatric stress, anxiety disorders, Stress related anxiety, Prolonged illness, and convalescence
Renalka ®	5 mL syrup has 50 mg shatavari root extract	Burning micturition, Cystitis, Dysuria, Hematuria, RUTI
Menosan ®	Each tablet has 110 mg Shatavari root extract	Natural menopause, Surgical menopause
Himplasia®	Each tablet has 80 mg Shatavari root powder	Benign prostatic hyperplasia
EveCare®	5 mL syrup has 32mg shatavari root extract	Dysmenorrhea, Menorrhagia, Metrorrhagia, Oligomenorrhea

Table 8: Shatavari Ayurvedic dosages.

Churna (powder)	¼ to ½ tsp consumed twice a day, mixed with milk, juice, or warm water.
Arishta (Aqueous Tincture)	1-2 tsf , twice a day
Vati (Tablet/ Capsule)	1-2 vatis, twice daily
Kashayam (Juice)	2-3 tsf once a day
Avaleha (Paste)	¼ - ½ tsf

kshyajit, krimihara, kanthya, arsha, krichra, pushtida.

Shatavari Ayurvedic Formulation

Shatavari Guggulu

Guggulu pacifies Vata doshas, stimulates neuromuscular actions, muscles strengthening, nerve revitalization and treats condition like paralysis and hemiplegia. It has shatavari, giloy, ashwagandha, padmaka, pippali, saunf, ajwain, sonth, gandha prasarni, gokshura, rasna, kachur, shuddha guggulu, cow's ghee. Small Vatakam of all ingredients (fine powdered mixture with ghee) can be stored in a glass jar as medicine. 1-2 Vatakam with water/warm milk can be taken twice a day in empty stomach or 1 hour before a meal or 2 hours after a meal.

Shatavari Kalpa

Shatavari Kalpa is amalgamation of shatavari and elaichi to enhance breast milk production and reduce pain and fatigue. It balances the vatta and pitta dosha. It improve immunity and stamina in menstruation, during pregnancy and post-natal. 4g shatavar, 0.05g elaichi, 5.95g sugar in each 10 gm formulation. Sieve the sun dried grinding powder of sugar and elaichi and mix with melted sugar. Cooled solution can be rolled into small granules and stored in container. It is used as anti-inflammatory, antioxidant, carminative, estrogenic, galactagogue. Dose is 1-2 tsf two times a day with warm milk.

Effect on Doshas

Shatavari have Snigdha (oily) and Guru (heavy) guna which leads to appeases the pitta (fire and air) doshas. It has Madhur (sweet) and tikta rasa (bitter). It has shit viraya (cold potency) and Madhur vipaka (sweet metabolic taste) which often aggravates kapha (earth and water) doshas (Table 8).

Conclusion

A. racemosus is an important medicinal plant from ancient times. It is used for making allopathic, ayurvedic and homeopathic medicines. In this review a brief evaluation of Shatavari properties are discussed to explain the practical clinical applications of various parts of the plants. Considerable work has been done to explore the biological activity and medicinal applications of the plant and major studies were reported using root extracts of the plant; still the active principle involved behind these activities needs to be explored. There are several therapeutic applications viz. antioxidant, diuretic, antidepressant, antiepileptic, antitussive, anti-HIV, immunostimulant, hepato-protective, cardio-protective, antibacterial, anti-ulcerative, neurodegenerative. Several studies have been conducted on different parts of *A. racemosus*, this plant has developed as a drug by pharmaceutical industries. The uniformity of quality and quantity both are prime important for this medicinal plant as it depends on active principle in it.

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Conflict of Interest

The authors declare no conflict of interest.

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