

A Review on Pharmacological and Phytochemical Profile of *Asparagus racemosus* Willd.

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Summary

Ayurveda, an orthodox as well as main stream system of medicine has been with a source of new concepts and products for healthcare. *Asparagus racemosus* Willd. is an advantageously authenticated medicinal plant as observable from the literature. *A. racemosus* has also been used successfully by some Ayurvedic practitioners for inflammation, hepatic disorders, neurological disorder and certain infectious diseases. This study is a collective information concerning the ethnobotany, pharmacology, phytochemistry and biological activities of the *Asparagus racemosus* Willd.

Key words: *Asparagus racemosus*; Satavri, Satmuli.

Introduction

The World Health Organization has estimated that 80% of the population of developing countries being unable to afford pharmaceutical drugs trust on conventional medicines,¹ mainly herbal based, to extend their primary health care needs. India is one of the most medico-culturally diverse countries in the world where the medicinal plant sector is part of a time-honoured tradition that is respected even today. Here, the main traditional systems of medicine include Ayurveda, Siddha and Unani. The earliest mention of the use of plants in medicine is found in the Rigveda which was written between 4500 and 1600 BC. It is however in Ayurveda that the specific properties of plants and their use as medicinal drugs have been dealt with in great detail. 'Ayurveda' literally translated means science of life. Around 1250 plants are presently used in various Ayurvedic formulations. *Asparagus racemosus* Willd. is one such important medicinal plant which is regarded as a 'rasayana' (plant drugs promoting general well being by increasing cellular vitality and resistance) in the Ayurvedic system of medicine.²

Asparagus racemosus is an important medicinal plant of tropical and subtropical India. Its medicinal usage has been reported in the Indian and British Pharmacopoeias and in indigenous systems of medicine. The genus *Asparagus* includes about 300 species around the world. The genus is considered to be medicinally important because of the presence of steroidal saponins and sapogenins in various parts of the plant. Out of the 22 species of *Asparagus* recorded in India; *Asparagus racemosus* is the one most commonly used in traditional medicine.

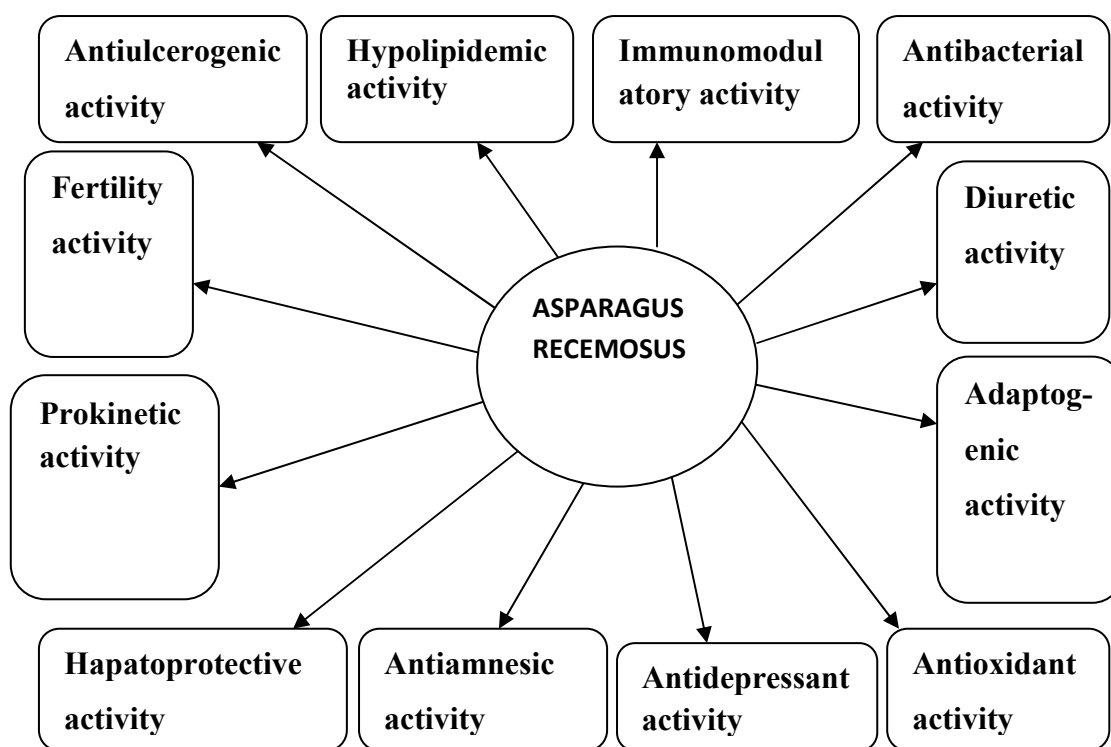


Figure 1: Medicinal properties of *A. racemosus*

Asparagus racemosus: the plant species *Asparagus racemosus* Willd. is commonly called Satavari, Satawar or Satmuli in Hindi; Satavari in Sanskrit; Shatamuli in Bengali; Shatavarior Shatmuli in Marathi; Satawari in Gujarati; Toala-gaddalu or Pilli-gaddalu in Telegu; Shimaishadavari or Inli-chedi in Tamil; Chatavali in Malayalam; Majjigegadde or Aheruballi in Kan-nada; Kairuwa in Kumaon; Narbodh or Satmooli in Madhya Pradesh; and Norkanto or Satawar in Rajasthan.³

The plant grows throughout the tropical and subtropical parts of India up to an altitude of 1500m. The plant is a spinous under-shrub, with tuberous, short rootstock bearing numerous succulent tuberous roots (30–100 cm long and 1–2 cm thick) that are silvery white or ash coloured externally and white internally.⁴ These roots are the part that finds use in various medicinal preparations. The stem is woody, climbing, whitish grey or brown coloured with small spines. The plant flowers during February–March leaving a mild fragrance in its surrounding and specially recommended in cases of threatened abortion and as a galactagogue.⁵ Root of *A. racemosus* has been referred as bitter-sweet, emollient, cooling, nervine tonic, constipating, galactagogue, aphrodisiac, diuretic, rejuvenating, carminative, stomachic, antiseptic and as tonic. Beneficial effects of the root of *A. racemosus* are suggested in nervous disorders, dyspepsia, diarrhoea, dysentery, tumors, inflammations, hyperdipsia, neuropathy, hepatopathy, cough, bronchitis, hyperacidity and certain infectious diseases.

Taxonomy

The plant belong to Kingdom: Plantae, *clade*: Angiosperms, *clade*: Monocots, Order: Asparagales, Family: Asparagaceae, Subfamily: Asparagoideae, Genus: *Asparagu,s* Species: *A. racemosus*.



Figure 2: *A. racemosus* Willd

Traditional uses of *Asparagus racemosus*

In ayurveda and Siddha

In Ayurvedic system of medicine Shatavari is indicated as brain tonic, epilepsy and for Vata disorders. It helps to regulate cardiac disorders and hypertension. It is extensively used in disorders of male genital dysfunctions, oligospermia spermatogenic irregularities and other male disorders such as painful micturation.⁹ It used in Ayurvedic formulations for digestive discomfort, indigestion, amoebiasis and piles. In females it is indicated in habitual abortitions, weakness of uterus, excessive bleeding during menstruation. Researches of modern times have proved that Shatavari is antidiarrhetic, antispasmodic, aphrodisiac, antidysenteric, demulcent, diuretic, galactagogue, nutritive, mucilaginous, refrigerant, stomachic properties and works as tonic for humanbeings. It also indicated in Ayurveda for general weakness due to prolong illnesses. Improves immunity and protects heart, brain and other vital organs of body.

Phytochemistry

The main active constituents of *Asparagus racemosus* are steroidal saponins (Shatavarins I–IV) that are present in the roots. Shatavarin IV is a glycoside of sarsasapogenin having two molecules of rhamnase and one molecule of glucose. Other active compounds such as quercetin, rutin (2.5% dry basis) and hyperoside are found in the flowers and fruits; while diosgenin and quercetin-3 glucuronide are present in the leaves.¹⁰ A new isoflavone, 8-methoxy-5, 6, 4'-trihydroxyisoflavone-7-O- β -d-glucopyranoside was also reported from *A. racemosus* previously. The isolation and characterization of polycyclic alkaloid called asparagamine, a new 9,10-dihydrophenanthrene derivative named racemosol and kaempferol were also isolated from the ethanolic root extract of *A. racemosus*. Oligofurostanosides.¹¹ Other primary chemical constituents of *Asparagus* are essential oils, asparagine, arginine, tyrosine and resin.^{12, 13}

Medicinal properties of *Asparagus racemosus*

Immunomodulatory activity

Aqueous extract of *A. racemosus* was fractionated and screened for the polysaccharide fraction. The characterization was done by enzymatic, Size Exclusion, gas chromatography with flame ionization detector (GC-FID), high pressure anion exchange chromatography (HPAEC) and thin layer chromatographic analyses. Phyto-chemical evaluation confirmed the presence of 26.7% of 2→1

linked fructo-oligosaccharides (FOS). They have a degree of polymerization (DP) of nearly 9-10. Cytotoxicity evaluation on P388 cell lines was consistent with low cytotoxicity of the extracts. In vitro Natural Killer (NK) cell activity was evaluated using human peripheral blood mononuclear cells (PBMC) isolated from whole blood on a ficoll-hypaque density gradient. K562 a myeloid leukemia cell line, were used as target cells. ARC, tested over the range 0.2-50 μ g/ml, showed a dose-related stimulation of NK cell activity with a peak increase of 16.9 \pm 4.4% at 5.6 μ g/ml. However, ARP demonstrated a higher stimulatory activity of 51.8 \pm 1.2% at 25 μ g/ml. The results indicate that the FOS from *A. racemosus* potentiates the NK cell activity and this could be an important mechanism underpinning the 'Rasayana' properties of this plant.¹⁴

Antibacterial activity

Methanolic extract of *Asparagus racemosus* shows antibacterial activity and it was tested by agar disc diffusion method in order to analyse the inhibitory activity of plant extract on the organisms.¹⁵

Hypolipidemic Activity

Aqueous extract of roots of *Asparagus racemosus* shown hypolipidemic activity by increase the level of catalase, SOD and ascorbic acid in hypercholesterolemic rats.¹⁶

Antidiabetic activity

Ethanollic extracts of *A. racemosus* roots have been shown to enhance insulin secretion in perfused pancreas and isolated islets. The extract significantly suppressed postprandial hyperglycaemia after sucrose ingestion and reversibly increased unabsorbed sucrose content throughout the gut. The extract also significantly inhibited the absorption of glucose during in situ gut perfusion with glucose. Furthermore, the extract enhanced glucose transport and insulin action in 3T3-L1 adipocytes. Daily administration of *A. racemosus* to type 2 diabetic rats for 28 d decreased serum glucose, increased pancreatic insulin, plasma insulin, liver glycogen and total oxidant status. These findings indicate that antihyperglycaemic activity of *A. racemosus* is partly mediated by inhibition of carbohydrate digestion and absorption, together with enhancement of insulin secretion and action in the peripheral tissue.¹⁷

Enzymes inhibitory activity

Methanolic extract of AR (MAR) significantly inhibited cholinesterase and MAO activities as compared to hexane (HAR) and chloroform (CAR) extracts of AR as evident from the IC(50) values.¹⁸

Hapatoprotective activity

AR extract (50 mg/kg) orally shows beneficial effect on isoniazid-induced hepatotoxicity in male albino rats. by Evaluated body weight, serum levels of alanine aminotransferase, aspartate aminotransferase, alkaline phosphatase, g-glutamyl transferase, total protein, albumin, hepatic malondialdehyde content, superoxide dismutase, catalase, cytochrome P450 2E1 (CYP2E1) activity and glutathione (GSH).¹⁹

Fertility activity

Lyophilised aqueous extracts of *Asparagus racemosus* Willd. (AR) were orally administered at 100 mg/kg body weight to Wistar strain male albino rats shows beneficial effect. Penile erection index and sperm count were determined by visual observation; the seminal fructose concentration was measured spectrophotometrically using resorcinol reagent; and NO release was assessed in a mouse macrophage cell line (RAW264) spectrophotometrically using a commercial Griess reagent kit. Penile erection index, sperm count, seminal fructose concentration and in vitro NO release were the parameters measured. A significant effect on the sperm count, seminal fructose content and penile erection index was observed upon treatment with the extracts.²⁰

Anti-HIV activity

Various extracts were prepared from AR plant. Anti-HIV activity was measured in a human CD4+ T-cell line, CEM-GFP cells infected with HIV-1NL4.3. AR reduced viral production in CEM-GFP cells infected with HIV-1NL4.3. *Asparagus racemosus*, demonstrated promising anti-HIV potential and were investigated for their active principles.²¹

Diuretic activity

Aqueous extract of the roots of *Asparagus racemosus* utilizing three doses 800 mg/kg, 1600 mg/kg and 3200 mg/kg shows diuretic activity in comparison with standard drug furosemide.²²

Antiamnesic activity

Methanolic extract of *Asparagus Racemosus* (AR) was Rats pre-treated with MAR (50, 100 and 200mg/kg, p.o) for 7 days showed significant decrease in escape latency in the MWM test indicating nootropic activity. MAR also significantly reversed scopolamine and sodium nitrite-induced increase in transfer latency on EPM indicating anti-amnesic activity.²³

Anticandidal Activity

The in vitro anticandidal activity of *Asparagus racemosus* roots and tubers extract was investigated against *Candida albicans*, *Candida tropicalis*, *Candida krusei*, *Candida guilliermondii*, *Candida parapsilosis* and *Candida stellatoidea*, which are isolated from vaginal thrush patients. The extract of *Asparagus racemosus* showed high degree of activity against all the *Candida* strains. The inhibitory effect of the extract against all the *Candida* tested was found comparable with that of standard antibiotics used.²⁴

Anti-parasitic activity and cytotoxicity

Aqueous extracts of *Asparagus racemosus* shows antiparasitic and cytotoxicity against 2 laboratory-adapted *Plasmodium falciparum* isolates (D6, CQ-sensitive and W2, CQ-resistant).²⁵

Antidepressant activity

Methanolic extract of roots of AR shows antidepressant effect. Rats were given MAR in the doses of 100, 200 and 400 mg/kg daily for 7 days and then subjected to forced swim test (FST) and learned helplessness test (LH). The results show that MAR decreases immobility in FST and increases avoidance response in LH indicating antidepressant activity.²⁶

Antiulcerogenic activity

Asparagus racemosus (Shatavari) crude extract (100 mg/kg/day orally) for fifteen days significantly reduced ulcer index when compared with control group. The reduction in gastric lesions was comparable to a standard antiulcer drug Ranitidine (30 mg/kg/ day orally). Crude extract also significantly reduced volume of gastric secretion, free acidity and total acidity. A significant increase in total carbohydrate (TC) and TC/total protein (TP) ratio of gastric juice was also observed.²⁷

Antioxidant activity

Methanolic extract (100 mg/kg BW/day p.o.) given orally for 15 days significantly increased in antioxidant defense, that is, enzymes superoxide dismutase, catalase, and ascorbic acid where as a significant decrease in lipid peroxidation was observed.²⁸

Anti-diarrhoeal activity

Ethanol and aqueous extracts of Asparagus racemosus root 200 mg/kg was shown Anti-diarrhoeal activity on castor oil-induced diarrhoea model in rats.²⁹

Antiparkinsonian activity

Extract of AR shows antiparkinsonian effect on Excitotoxic kainic acid induced of neuronal cell death in neurodegenerative disorders that occurs in both Alzheimer's and Parkinson's diseases. The results showed impairment of hippocampus and striatal regions of brain after KA injection marked by an increase in lipid peroxidation and protein carbonyl content and decline in glutathione peroxidase (GPx) activity and reduced glutathione (GSH) content. The AR extract supplemented mice displayed an improvement in GPx activity and GSH content and reduction in membranal lipid peroxidation and protein carbonyl. We show that the minimizing effect of AR extract on oxidative damage in addition to the elevation of GPx activity and GSH content could eventually result in protective effect on the KA-induced excitotoxicity.³⁰

Antitussive activity

The methanol extract of Asparagus racemosus root (200 and 400 mg/kg, p.o.) showed significant antitussive activity on sulfur dioxide-induced cough in mice, the

cough inhibition (40.0 and 58.5%, respectively) being comparable to that of 10-20 mg/kg of codeine phosphate (36.0 and 55.4%, respectively).³¹

Prokinetic activity

Asparagus racemosus, shows reduce gastric emptying time and gastric emptying half-time (GE t_{1/2}). The basal GE t_{1/2} in volunteers was 159.9 ± 45.9 min (mean ± SD) which was reduced to 101 ± 40.8 min by Shatavari (p less than 0.001) and to 85.3 ± 21.9 by metoclopramide (p less than 0.001). Metoclopramide and Shatavari did not differ significantly in their effects.³²

Adaptogenic activity

Asparagus racemosus is described in Ayurveda as a 'rasayana' herb. 'Rasayana' is a group of plant drugs known to promote physical and mental health, improve defence mechanisms of the body and enhance longevity. These attributes are similar to the modern concept of 'adaptogens' which are the agents that increase the non-specific resistance of organisms against a variety of stresses.³³

Cerebroprotective activity

Methanolic extract of root of *A. racemosus* at dose 200mg/kg and 400 mg/kg effective in global cerebral ischemia which is induced by bilateral carotid artery occlusion method.³⁴

Antineoplastic activity

Chloroform/methanol (1:1) extract of fresh root of *A. racemosus* has been reported to retard the tumor incidence in female rats treated with DMBA (7,12 dimethyl benz (a) anthracene).³⁵

Conclusion

In recent years, ethnomedicinal studies received much attention as this brings to light the numerous little known and unknown medicinal virtues especially of plant origin. Pharmacological screenings of *A. racemosus* Willd. revealed its medicinal potential and represents as a valuable medicinal plant with several medicinal properties. As the pharmacologists are looking forward to develop new drugs from natural sources, development of modern drugs from *A. racemosus* Willd. can be emphasized for the control of various diseases. A systemic research and

development work should be undertaken for the conservation of *A. racemosus* Willd. and development of products for their better economic and therapeutic utilization.

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