

SHATAVARI (ASPARAGUS RACEMOSUS WILD): A REVIEW ON ITS CULTIVATION, MORPHOLOGY, BIOLOGICAL ACTIVITIES & PHARMACOLOGICAL IMPORTANCENutan Sharma^{1*}, Omprakash Sharma² and Naresh Garg²¹PG Scholar Department of Dravyaguna Vigyan,²Professor and HOD Department of Dravyaguna Vigyan,

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Article Received on 27/05/2021

Article Revised on 17/06/2021

Article Accepted on 07/07/2021

ABSTRACT

Asparagus racemosus, a climbing Ayurvedic plant, is known for its numerous activities such as hyperlipidemia, hypertension, angina, dysmenorrhea, anxiety disorders, cough, benign prostatic hyperplasia (BPH), leucorrhoea and urinary tract infections. This plant possesses a wide range of secondary metabolites inclusive of steroids, alkaloids, dihydrophenanthrene derivatives, flavonoids, furan derivatives and essential oils. Information from the literature suggests that, the major constituents of *A. racemosus* are steroidal saponins which are mainly responsible for different biological activities of *A. racemosus*. The review summarizes the information concerning the cultivation, morphology and pharmacological importance

KEYWORDS: *Asparagus racemosus*, Shatavarins, Racemosides, Morphology.**INTRODUCTION**

The genus *Asparagus* consisted of about 300 species around the world, out of which 22 species are recorded in India. *A. racemosus* is widely distributed across the globe and its distribution ranges from tropical Africa, Java, Australia, Sri Lanka, Southern parts of China and India, but it is mainly cultivated in India.^[1]

Classification

Kingdom Plantae
Order Asparagales
Family Asparagaceae
Sub family Asparagoideae
Genus *Asparagus*
Species *Asparagus racemosus* L

Vernacular names^[2]

Sanskrit Satavari
Hindi Satavari, Shatawar or Satmuli
Bengali Shatamuli
Marathi Shatavari or Shatmuli
Gujarati Satawari
Rajasthan Norkanto or Satawar

Description

A. racemosus is an important medicinal plant which is regarded as a 'rasayana' which means plant drugs promoting general well-being by increasing cellular vitality and resistance.^[3] Use of *A. racemosus* is

mentioned in the ancient literature of Ayurveda (Charaka samhita).^[4] Traditionally, *A. racemosus* is indicated in epilepsy, vata disorders,^[5] brain tonic, helps in regulating cardiac disorders and hypertension.^[6]

It is extensively used in male genital dysfunctions, oligospermia, spermatogenic irregularities and other male disorders such as painful micturition.^[7,8] It is also explored in Ayurvedic formulations for digestive discomfort, indigestion, amoebiasis, piles and debility^[9,10] In females, prescribed by the doctors in habitual abortions, weakness of the uterus, excessive bleeding during menstruation.^[11] Recent reports and experiments disclosed Shatavari as antidiarrheic,^[12] antispasmodic, aphrodisiac,^[9] antidysentery, demulcent, diuretic,^[13] galactagogue, nutritive, mucilaginous, refrigerant, stomachic properties and works as a tonic for human beings.^[14] It is also known to reinforce the immune system and protect vital organs like heart,^[15] brain^[16] and other organs of the body. This review is a discussion about the cultivation, morphology, biological activities, safety profile and conservation techniques for this plant.

Cultivation and Morphology

Traditionally the decorticated roots of the plant have been used as a remedy for diseases of spleen, liver and other internal organs, including preventing miscarriage.^[17] In India, conventionally the roots have

been utilized during internal pain, tumors, fever and as a tonic.^[18] *A. racemosus* (Shatavari) is a climbing plant consisting of tuberous roots.^[5] According to Indian pharmacopoeia, *A. racemosus* contains not less than 0.1 per cent of Shatavarin IV, as calculated on the dried weight basis.^[14] The taste is initially starchy and then slightly bitter followed by a sweet taste. *A. racemosus* has small pin-needle like phylloclades (photosynthetic branches) which are uniform and shiny green in appearance.

The roots, 5-15 cm in length and 2 cm in thickness, are marketed in the form of pieces. These are silvery white or ash-colour externally and white internally. Roots are more or less smooth when fresh, and start to develop longitudinal wrinkles upon drying.^[10] Microscopically the inner parenchymatous zone of cortex is composed of 18-24 layers in the upper portion and 42-47 layers in the middle tuberous portion of the roots. Cells are thin-walled and composed of cellulosic fibres; with circular to oval outlines and distinct inter cellular spaces. In some roots 3-4 layers of cortex immediately adjacent to the

endodermis are modified into a sheath of stone cells round the endodermis.

The number of vascular bundles ranges from 30-35 in the upper levels and 35-45 in the middle tuberous portions of the roots.^[16] The roots upon grinding are light brown in colour with a coarse texture. The plant prefers light (sandy), medium (loamy) and heavy (clay) soil. Black, well drained and fertile soil are highly favourable for *A. racemosus* cultivation^[4] and can also be cultivated in loose and medium black soil. Crops mainly need tropical, hot climatic conditions and require minimum irrigation with the avoidance of over-watering. Raised beds which are about 3m are harvested in the month of May or June. The time of transplanting is in the month of July-August. It produces minute flowers in the month of July which are white and unisexual in nature.^[19]

In September, it begins to bear fruits which are globular or obscurely 3 lobed, pulpy berries which are purplish black when they are ripening, seeds are hard and brittle.^[14]



Fig. 1: *Asparagus racemosus* showing (a) Shoot, leaves and tuberous roots^[21] (b) Powdered roots (c) berries.^[20]

Biological activities

Nutritional studies demonstrated that *Asparagus* is a low-calorie source of folate and potassium.

The plant is widely used in about 64 Ayurvedic formulations which include traditional formulations such as 'Shatavari Kalpa', 'Phalaghrita', 'Vishnu taila'.^[2] The plant has numerous traditional practices and these traditional practices were verified by the experimental studies.

1. Antioxidant property: Crude extract and purified aqueous fraction of *A. racemosus* have been demonstrated for its antioxidant effect.^[46] The extract exhibited antioxidant effect against oxidative damage by providing protection against lipid peroxidation, protein oxidation and depletion in the levels of protein thiols and antioxidant enzyme, superoxide dismutase. The purified aqueous fraction which consisted of polysaccharides was found to be a potent antioxidant as compared to the crude extract. Purified fraction was more effective against

lipid peroxidation whereas the antioxidant effect of the crude extract was more effective in inhibiting protein oxidation. The crude and purified extracts indicated protection against radiation induced loss of protein thiols and inactivation of superoxide dismutase.^[46]

- 2. Diuretic activity:** The diuretic property was highlighted in Ayurveda has been validated by a suitable experimental model. Study was carried out using an aqueous extract of the roots utilizing three dose vials 800 mg/kg, 1600 mg/kg and 3200 mg/kg for its diuretic activity.
- 3. Antidepressant activity:** The methanolic extract decreased immobility periods significantly in TST, FST, which indicated significant antidepressant activity underlining the fact that the efficiency of the extracts was comparable to fluoxetine and imipramine used as reference drugs in the study. Methanolic extract significantly decreased brain MAO-A (Monoamine Oxidase A) and MAO-B

(Monoamine Oxidase B) activity levels it has been found that the methanolic extract possesses antidepressant activity probably by inhibiting MAO-A and MAO-B; and through interaction with adrenergic, dopaminergic, serotonergic and GABAergic systems (Gamma aminobutyric acid).^[52]

4. **Antiepileptic effect:** The anticonvulsant activity was evaluated using different extracts on seizures. The methanolic extract has shown significant anticonvulsant effect which was anticipated by the observation of a decrease in the duration of the hind limb extension, clonus and also the duration of stupor phase. There was a prolonged onset of the tonic clonic seizure induced by pentylenetetrazol in the groups treated with methanolic and aqueous extracts and mechanism behind the activity was GABAergic.^[55]
5. **Antitussive effect:** The methanolic extract of roots has been reported to possess antitussive. Antitussive effect produced was dose dependent for both extracts as well as standard drug which further supported the claims put forward by traditional medicine practitioners about the usefulness of *A. racemosus* in the treatment of cough.
6. **Antileishmanial activity:** Leishmaniasis can occur in diverse clinical forms such as cutaneous, mucosal, visceral leishmaniasis (VL, the most severe) and remain a major health problem in the tropical and subtropical areas, threatening almost 350 million people in 88 countries.^[57,58] The viability of promastigotes after treatment with Racemoside A (2).
7. **Anti-plasmodial activity:** The ethyl acetate extract of the roots of *A. racemosus* has been tested for anti-plasmodial activity. The extract with yield value of 7.9% per 100g have shown dose dependent inhibition of chloroquine resistant strain of *Plasmodium falciparum* (3D7) with an IC₅₀ value of 29µg/mL.^[61]
8. **Anti-HIV activity:** *A. racemosus* is also known to show immunomodulatory activity. Steroidal saponin glycosides (19-24) have been reported from these extracts. Compound 19 isolated from the ethanolic extract exhibited the highest anti-HIV activity as compared to other saponin glycosides.^[35]
9. **Immunostimulant:** Immunodeficiency disorders are the group of disorders in which the body's defence system is compromised, making it to be less effective against foreign invaders. As a result, the person with an immunodeficiency disorder will have frequent infections that are generally more severe and remain longer than usual. Isolated polyhydroxylated steroidal saponin acids (13-15) were studied on the immune system of normal and

cyclosporine-A induced immune-suppressed animals and has been found that compound is a potent immune system stimulator.^[30]

Pharmacological importance

1. **Hepatoprotective Activity:** of glutathione levels in cases with isoniazid toxicity upon extract administration was observed.^[64] Hepatoprotective activity was resultant of inhibited production of free radicals, acting as a scavenger and reducing the free radical generation via inhibition of hepatic CYP2E1 activity.^[65,11] In paracetamol induced liver injury in rats there is increased levels of SGOT, SGPT, serum bilirubin and serum alkaline phosphatase, upon treatment with the ethanolic roots extract and reversal in their levels indicating the hepatoprotective activity and there was an improvement in their levels.^[66]
2. **Antibacterial activity:** The root extracts of *A. racemosus* have been studied for antibacterial activity employing standard cylinder method. Microbes used were *Bacillus subtilis*, *Staphylococcus aureus*.^[67] *Staphylococcus wernerii*, *Pseudomonas aeruginosa* and *Escherichia coli*, *Proteus mirabilis*, *Klebsiella pneumoniae*, *Pseudomonas putida*. Both gram-positive and gram-negative bacteria were sensitive to the extract.
3. **Pregnancy**
 1. **Anti abortifacient:** The formulations containing *A. racemosus* roots (eg. Shatavari sidh ghril) were prescribed in the cases of threatened abortions.^[68] The observed activity was due to the Shatavarin-I.^[69] (7). *In vivo* effect of shatavarin IV (12) i.e. saponin A4 on the uterine muscles was similar to the estrogen.^[70] The polycyclic alkaloid asparagamine A (28) have been reported to possess an anti-oxycotic action.^[38] and showing an anti abortifacient affect.
 2. **Antenatal tonic:** A capsule Sujat containing *A. racemosus* extract, There was reduction in the incidence of pregnancy induced hypertension (PIH). PGI₂ and NO (nitric oxide) are the important vasodilators; a deficiency of these can lead to PIH.
 4. **Anti-Ulcer:** The protective activity of the extract was due to the increase in mucosal defensive factors like mucus secretion, cellular mucus, life span of cells and anti-oxidant effect. A marked decrease in cell shedding and increase in mucin secretion indicated its predominant effect on mucosal defensive factors.^[16] There was a significant reduction in ulcer index and reductions in the volume of gastric secretion upon treatment. It has been concluded that *A. racemosus* have an antiulcerogenic activity. The activity was the result of inhibitory effect on release of gastric hydrochloric acid and protects gastric mucosal damage.^[73] In humans, *A. racemosus* root powder is effective in

chronic peptic ulcers. There was an increase in the lifespan of gastric mucosal epithelial cells, secretion and viscosity of gastric mucus.^[74]

5. **Anti-diarrheal activity:** in today era, diarrhoea is the reason for three-fourth of infant and childhood mortality.^[75] The use of oral dehydration therapy reduced mortality but chronic diarrhoea is still a life-threatening problem in the regions where malnutrition is a regular co-existing and complication factor. The extracts of *A. racemosus* were evaluated for its anti-diarrheal activity. The ethanolic and aqueous extracts have been shown to possess inhibitory activity against gastrointestinal tract motility.
6. **Anticandidal activity:** Experimental findings suggested that methanol extracts possessed high anticandidal activity against different *Candida* species.
7. **Anti-aflatoxic activity:** Fourteen essential oils constituents were obtained from the bio deteriorated *A. racemosus* which were tested as individual component as well as in combination their anti-aflatoxic activity. Constituents obtained were thymol (55), eugenol (56), menthol (57), geranyl acetate (58), linalool (59), β -asarone (60), 1, 8-cineol (61), E-citral (62), β -caryophyllene (63), α -pinene (64), carvone (65), p-cymene (66), carvacrol (67), ocimene (68) (figure 3). Among 14 constituents, thymol and eugenol showed potent fungicidal activity since both caused blocking of the growth of spores and the rest of essential oil constituents showed moderate antifungal activity.^[44]
8. **Cardio protective effects:** formulation manufactured by Himalayan drugs named abana, have been found useful in controlling hypercholesterolemia, prevention and management of coronary heart disease. Abana was given in normal as well as in cases of essential hypertension and angina pectoris and was found to reduce the total cholesterol and triglyceride levels. There was an observed significant increase in high-density lipoprotein cholesterol levels.^[77] Significant increase in plasma HDL-C levels with a concurrent decline in the plasma cholesterol level and an improvement. The reduction in the levels of HDL-C is an indicative of high risk of cardiovascular disease, so improvement in its levels gives cardioprotective activity.^[15]
9. **Neurodegenerative disorders:** formulation consisting of standardized extracts has been used as anti-stress agent to ease the various aspects of stress related disorders. The extract showed normalization in the elevated levels of NA (nor-epinephrine), DA (dopamine), 5HT (5-hydroxy tryptamine) concentrations, which were increased by chronic

electroshock stress. Decrease in neurochemical levels in the brain indicates the effectiveness of the formulation in neurological disorders.^[78] It has been found to be effective in neurodegenerative disorders like Alzheimer's and Parkinson's disease. The potential of methanolic root extract roots against kainic acid induced hippocampal and striatal neuronal damage. They concluded; plant extract plays the role of an antioxidant by attenuating free radical induced oxidative damage. The oxidative damage protection of the hippocampal and striatal regions of the brain is useful in the neuro degenerative disease.^[79]

10. **Anti-cancer property:** The root extract was shown to have a protective effect in the mammary cell carcinoma.^[80] Steroidal components of the *A. racemosus* were investigated for the apoptotic activity and inferred to have the capacity to tumor cell death.^[81] Anticancer activity of shatavarins (containing Shatavarin IV) (12) which was isolated from the roots of have been evaluated by MTT assay using MCF-7 (human breast cancer), HT-29 (human colon adenocarcinoma) and A-498 (human kidney carcinoma). The experimental results suggested that the extract (containing Shatavarin IV) possess potent anti-cancer activity.^[82]

CONCLUSION

A. racemosus is an important medicinal plant having traditional importance as it is used in the indigenous system of medicines like Ayurveda, Sidha and Unani. Traditional practices are proven by various experimental and scientific studies and needs furthermore to be explore.

The plant has numerous therapeutic applications *viz.* antioxidant, diuretic, antidepressant, antiepileptic, antitussive, anti-HIV, immunostimulant, hepato-protective, cardio-protective, antibacterial, anti-ulcerative, neurodegenerative. Formulations containing *A. racemosus* as the major ingredient against numerous disorders indicate its economic and therapeutic importance worldwide. The safety profile analysis showed that the *A. racemosus* is safe in therapeutic doses and can be used during pregnancy with a caution.

Furthermore, the optimization of environmental conditions and the development of appropriate agro techniques would enhance the quality and quantity of the overall production. This in turn would encourage farmers to undertake commercial cultivation of *A. racemosus*.

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