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Asparagus racemosus (Willd): Biological Activities & its Active Principles

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Abstract— *Asparagus racemosus* Willd. (Liliaceae) known as 'Shatavari'. The major active constituents of *Asparagus racemosus* are steroidal saponins (Shatavarins I-IV). Isoflavones, Asparagamine, Racemosol, Polysaccharides, mucilage, vitamins A, B_1 , B_2 , C, E, Mg, P, Ca, Fe, and folic acid present in roots. Other primary chemical constituents of *Asparagus* are essential oils, asparagine, arginine, tyrosine, flavonoids (kaempferol, quercetin, and rutin), resin, and tannin. It is a well known Ayurvedic rasayana which prevent ageing, increase longevity, impart immunity, improve mental function, vigor and add vitality to the body. It is also used in nervous disorders, dyspepsia, tumors, inflammation, neuropathy and hepatopathy.

Keywords : Shatavari, Shatavarins I-IV, Racemosol, Antiageing.

INTRODUCTION

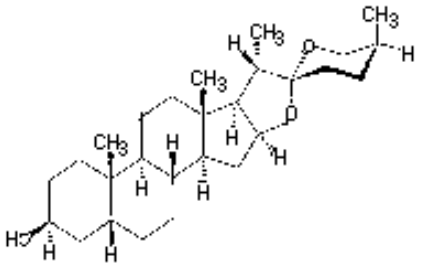
Asparagus racemosus Willd. (Liliaceae), commonly known as 'Shatavari', is a much-branched, spinous under shrub found growing wild in tropical and sub-tropical parts of India. Shatavari is a woody climber growing to 1-2 m length. The leaves are like pine-needles, small and uniform. The inflorescence has tiny white flowers, in small spikes and the roots are finger-like and clustered [1]. Vernacular Names are Oriya: Shatabari, Hindi: Satavar, Bengali: Shatamooli, Marathi: Shatavari, Gujarati: Shatawari, Telugu: Challan gadda, Tamil: Sadawari, Kannada: Majjigegade. The plants, of the liliaceae family, is common at low altitudes in shade and in tropical climates throughout India, Asia, Australia and Africa[2]. In Indian system of medicine *Asparagus racemosus* is an important medicinal plant and its root paste or root juice has been used in various ailments and as health tonic [1,2]. *Asparagus racemosus* is a well known Ayurvedic rasayana which prevent ageing, increase longevity, impart immunity, improve mental function, vigor and add vitality to the body and it is also used in nervous disorders, dyspepsia, tumors, inflammation, neuropathy, hepatopathy [3]. Reports indicate that the pharmacological activities of *Asparagus racemosus* root extract include antiulcer [4], antioxidant, antidiarrhoeal, antidiabetic and immunomodulatory activities. A study of ancient classical Ayurvedic literature claimed several therapeutic attributes for the root of *A. racemosus* and has been specially recommended in cases of threatened abortion and as a galactogogue. Root of *A. racemosus* has been referred as bitter-sweet, emollient, cooling, nervine tonic, constipating, galactogogue, aphrodisiac, diuretic, rejuvenating, carminative, stomachic, antiseptic[35] and as tonic. Beneficial effects of the root of *A. recemosus* are suggested in nervous disorders, dyspepsia, diarrhoea, dysentry, tumors, inflammations, hyperdipsia, neuropathy, hepatopathy, cough, bronchitis, hyperacidity and certain infectious diseases. This review describes various pharmacological properties of the root extract of *A. racemosus* evaluated/reported so far. The major active constituents of *Asparagus racemosus* are steroidal saponins (Shatavarins I-IV) that are present in the roots. Shatavarin IV has been reported to display significant activity as an inhibitor of Core 2 GlcNActransferase in cell free assays and recently to exhibit immuno-modulation activity against specificT-dependent antigens in immuno compromised animals [5].

Cultivation:

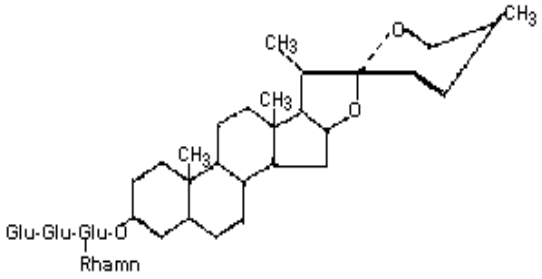
The plant prefers light (sandy), medium (loamy) and heavy (clay) soil. Black, well drained and fertile soil is good for cultivation. But can be cultivated in loose and medium black soil. Crop responses well to tropical and hot climate. The tamarind is adapted to semiarid regions of the tropics and can withstand drought conditions quite well. They require minimum irrigation so avoid over-watering, one ploughing, three harrowings and then Apply 20-25 tons of farm yard manure for fertilisation. *Harvest*- raised beds -1x3 m in the month of May or june. *Seed*- one kg for one hectare area. Apply 50 gram urea in the bed after 20-25 days. Seedlings become ready within 6-8 weeks for transplantation in the main field. For Transplanting the requirements are- size of pit-45x45x45, spacing-row to row-1.5m and plant to plant-1.0m, Fill the pits with 20-30 gram lindane or carbaryl and 5 kgs of FYM, time of transplanting – july-august, provide the crop with 50 gm of 15:5:15(suphala) per plant when it starts with good growth. Carry out timely weeding operations. Generally shatavari crop does not affect with pest and diseases. *Harvesting*- first harvesting- 1.5-2 years after transplanting, which continues for 10-15 years. Male and female plants must be grown if seed is required [6,7].

PHYTOCONSTITUENTS

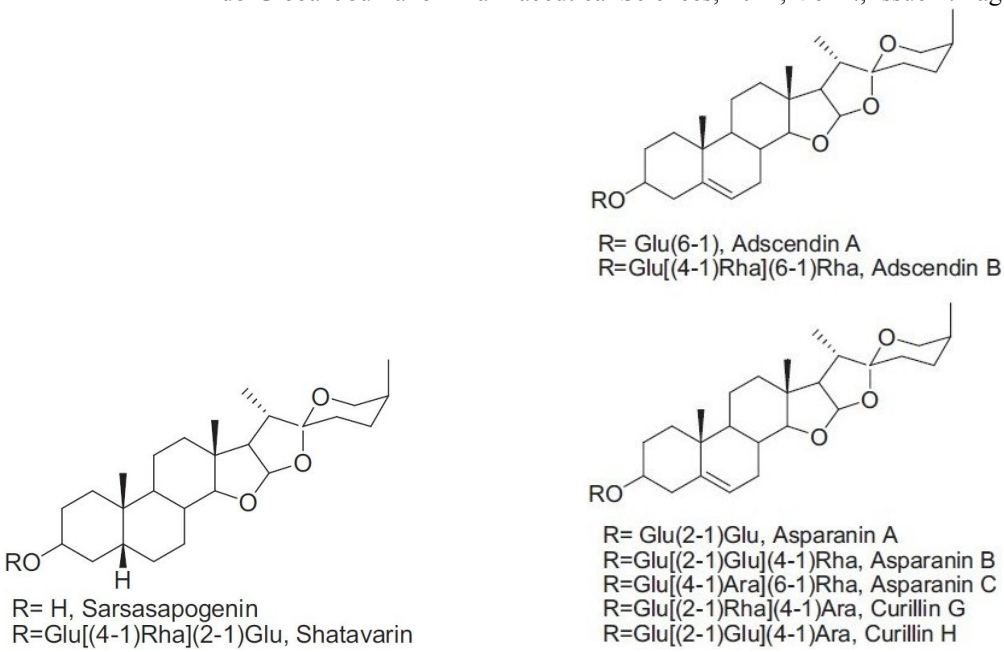
Recent chemical analysis indicate that the following active constituents are present is *Shatavari* plant: Steroidal saponins, known as shatavarins (I, IV), sarsasapogenin, adscendin (A, B), asparanin (A,B,C). Shatavarin I is the major glycoside with 3 glucose and rhamnose moieties attached to sarsasapogenin. Shatavarin IV is a glycoside of sarsasapogenin having 2 molecules of *Asparagus* rhamnose and 1 molecule of glucose. Sarsasapogenin and shatavarin I-IV are present in roots, leaves, and fruits of *Asparagus* species. Synthesis of sarsasapogenin in the callus culture of *A. racemosus* was also reported [8,9]. 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* (curillins G and H) and spirostanosides (curilloside G and H) have been isolated from the roots and sarsasapogenin from leaves of *A. curillus*. This plant also contains vitamins A, B_1, B_2, C, E, Mg, P, Ca, Fe, and folic acid. Other primary chemical constituents of *Asparagus* are essential oils, asparagine, arginine, tyrosine, flavonoids (kaempferol, quercetin, and rutin), resin, and tannin [10,11]. The major bioactives (Chemical constituents) of *Asparagus* species are shown in Figure I.



Sarasasapogenin



Shatavarin I



Shatavarin IV

Figure 1 Chemical constituents of Asparagus species

BIOLOGICAL PROFILE

Asparagus racemosus (Shatavari) is used by ayurvedic doctors for the prevention and treatment of gastric ulcers, dyspepsia and as a galactogogue. It has also been used successfully by some ayurvedic practitioners for nervous disorders, inflammation, liver diseases and certain infectious diseases. Recently few reports are available demonstrating beneficial effects of alcoholic and water extracts of the root of *Asparagus racemosus* in some clinical conditions and experimentally induced diseases, e.g. galactogogue effect, antihepatotoxic and immunomodulatory activities.

Gastrointestinal effects:

The powdered dried root of *A. racemosus* is used in ayurveda for dyspepsia. Oral administration of powdered dried root of *A. racemosus* has been found to promote gastric emptying in healthy volunteers. Its action is reported to be comparable with that of the synthetic dopamine antagonist metoclopromide [12]. In ayurveda,it has also been mentioned for the treatment of ulcerative disorders of stomach and Parinama Sula, a clinical entity akin to the duodenal ulcer diseases. The juice of fresh root of *A. racemosus* has been shown to have definite curative effect in patients of duodenal ulcers [13]. *A. racemosus* along with *Terminalia chebula* reported to protect gastric mucosa against pentagastrin and carbachol induced ulcers, by significantly reducing both severity of ulceration and ulcer index [14]. Decreased volume and increased pH of the secretions in drug treated rats suggest a reduced responsiveness of the gastric parietal cells to secretogogues and narcotizing agents [14,15]. Cytoprotective effect has been suggested to be due to increased output of mucus. Shatavari promptly and persistently relieve the pain and burning sensation as well as other dyspeptic symptoms due to duodenal ulcer. Since Shatavari did not have antacid and anti-secretory properties, the observed mild reduction in acid secretion may be due to some changes in gastric mucosa. It has been suggested to heal the ulcers by potentiating defensive factors and many hypothesis have been put forward for its possible mechanism [15]. It may prolong the life span of mucosal cells, increase the secretion and viscosity of mucus and strengthen the mucosal barrier and thus reduces H^+ ion back diffusion into the mucosa, it may form a complex with mucous of other substances at the base of ulcer which may protect the ulcer from the corrosive and proteolytic effects of

acid-pepsin, It may have cytoprotective action like that of prostaglandins. Other possible mechanism may be deactivation and binding of pepsin or of bile salts. In addition to antiulcerogenic activity of *A. racemosus* in clinical trials, De et al [16] demonstrated similar effects of fresh root juice of *A. racemosus* in rats, using cold stress and pyloric-ligation induced gastric ulcer. In contrast to previous report [15] these workers suggested a reduction in acid and pepsin contents (aggressive factors) and increase in mucin-bicarbonate secretions and life span of the mucosal cells (defensive factors). Anti-ulcerogenic effect is suggested to be due to the regulation of the above two factors [17]. Various extracts from the root of *A. racemosus* have been shown to cause contraction of smooth muscles of rabbit's duodenum, guinea pig's ileum and rat's fundal strip without affecting peristaltic movement. These actions were found to be similar to that of acetylcholine and were blocked by atropine, suggesting a cholinergic mechanism of action. However, no effect was observed on isolated rectus abdominus [18].

Galactogogue effect

The root extract of *A. racemosus* is prescribed in ayurveda to increase milk secretion during lactation. It is in combination with other herbal substances in the form of 'Ricalex' tablets (Aphali pharmaceutical Ltd. Ahmednagar) has been shown to increase milk production in females complaining of deficient milk secretion [19]. Gradual decrease in milk secretion, on withdrawl of the drug suggested that the increase in milk secretion was due to drug therapy only and not due to any psychological effect. Systemic administration of the alcoholic extract of *A. racemosus* in weaning rats increased weight of the mammary glands, inhibited involution of lobulo-alveolar tissue and maintained milk secretion [20]. The same extract in estrogen-primed rats showed well developed lobulo-alveolar tissue and lactation. Increase in mammary gland weight and growth of the lobulo-alveolar tissue may be due to the action of released corticoids and prolactin [21]. In an another study, *A. racemosus* along with some other herbal substances in the form of a commercial preparation, lactare (TTK Pharma, Chennai) is reported to enhance milk output in women complaining of scanty breast milk, on 5th day after delivery [22]. A significant increase in milk yield has also been observed in guinea pigs and goats after feeding lactare which also increased growth of the mammary glands, alveolar tissues and acini in guinea pigs [23]. Patel et al [24] have also shown galactogogue effect of roots of *A. racemosus* in buffaloes. However, Sharma et al [25] did not observe any increase in prolactin levels in females complaining of secondary lactational failure with *A. racemosus* suggesting that it has no lactogenic effect.

Effects on uterus

Inspite of cholinergic activity of *A. racemosus* on guinea pig's ileum, ethyl acetate and acetone extracts of the root of *A. racemosus* blocked spontaneous motility of the virgin rat's uterus[18]. These extracts also inhibited contraction, induced by spasmogens like acetylcholine, barium chloride and 5-hydroxytryptamine whereas alcoholic extract was found to produce a specific block of pitocin induced contractions. On the other hand petroleum ether as well as ether extracts of the powdered roots did not produce any uterine activity. It indicates the presence of some particular substance in the alcoholic extract which specifically blocks pitocin sensitive receptors though not other receptors in the uterus [18], confirming that shatavari can be used as uterine sedative. Further, a glycoside, Shatavarin I, isolated from the root of *A. racemosus* has been found to be responsible for the competitive block of oxytocin-induced contraction of rat, guinea pig and rabbit's uteri, in vitro as well as in vivo [26].

Immunomodulatory activities

Intra-abdominal sepsis are major causes of mortality following trauma and bowel surgery. Immunomodulating property of *A. racemosus* has been shown to protect the rat and mice against experimental induced abdominal sepsis [27, 28]. Oral administration of decoction of powdered root of *A. racemosus* has been reported to produce leucocytosis and predominant neutrophilia along with enhanced phagocytic activity of the macrophages and polymorphs. Percentage mortality of *A. racemosus* treated animals was found to be significantly reduced while survival rate was comparable to that of the group treated with a combination of metronidazole and gentamicin [27, 28]. Since *A. racemosus* is reported to be devoid of antibacterial action, so protection offered by *A. racemosus* against

sepsis by altering function of macrophages, indicates its possible immunomodulatory property. Further, oral administration of total extract of *A. racemosus* has been shown to reduce all the three attributes of adhesions viz number, character and area markedly in an animal model of intraperitoneal adhesions [29]. It has reported the revival of macrophage chemotaxis and interleukin-I (IL-I) and tumor necrosis factor a(TNFa) production by the oral treatment of *A. racemosus* root extract in ochratoxin A treated mice [30]. Alcoholic extract has been found to enhance both, humoral and cell mediated immunity of albino mice injected with sheep red blood cells as particulate antigen [31].

Antihepatotoxic activity

Alcoholic extract of root of *A. racemosus* has been shown to significantly reduce the enhanced levels of alanine transaminase, aspartate transaminase and alkaline phosphatase in CC14-induced hepatic damage in rats, indicating antihepatotoxic potential of *A. racemosus* [31].

Antineoplastic activity

Chloroform/methanol (1:1) extract of fresh root of *A. racemosus* has been reported to reduce the tumor incidence in female rats treated with DMBA (7,12 dimethyl benz (a) anthracene) [32].This action is suggested to be mediated by virtue of mammotropic and/or lactogenic [20] influence of *A. racemosus* on normal as well as estrogen- primed animals, which renders the mammary epithelium refractory to the carcinogen [32].

Cardiovascular effects

Alcoholic extract of the root of *A. racemosus* has been reported to produce positive ionotropic and chronotropic effect on frog's heart with lower doses and cardiac arrest with higher doses. The extract was found to produce hypotension in cats which was blocked by atropine, indicating cholinergic mechanism of action. The extract also produced congestion and complete stasis of blood flow in mesentric vessels of mice and rat. Slight increase in the bleeding time and no effect on clotting time was observed on i.v. administration of the extract in rabbits [33].

Effect on respiratory system

Higher doses of the alcoholic extract of root of *A. racemosus* are reported to cause dilatory effect on bronchial musculature of guinea pigs but failed to antagonise the histamine induced broncho-constriction. The extract has also been reported to produce depression of respiration in cat [33].

Effect on CNS

Neither stimulant nor depressant action of lactare on central nervous system has been reported in albino mice. Shatavari did not produce catalepsy in experimental rats even with massive oral doses suggesting that its action may be outside the blood-brain barrier, similar to that of metoclopromide [23].

Miscellaneous effects

Alcoholic extract of root of *A. racemosus* was found to have slight diuretic effect in rats and hypoglycemic effect in rabbits, but, no anticonvulsant and antifertility effect was observed in rats and rabbits respectively. However, it did show some anti-amoebic effect in rats [33,34].

Toxic effects

In Ayurveda, *A. racemosus* has been described as absolutely safe for long term use, even during pregnancy and lactation. Systemic administration of higher doses of all the extracts did not produce any abnormality in behaviour pattern of mice and rat [18,23]. LD [50] of the product lactare has not been assessed since it did not produce mortality even upto the oral dosages of 64 gm/kg [35,36].

DISCUSSION & CONCLUSION

Requirements for herbal medicines have been established within last few years, and the trend is to define the dosage form with a uniform amount of extract. On the contrary most of the herbal drugs reduce the offensive factors and are proved to be safe, clinically effective, better patient tolerance, relatively less expensive and globally competitive. Treatment with natural products presents promise of a cure. *A. racemosus* plants have been raw material for the synthesis of many drugs and they remain an important source of new therapeutic agents. Extracts of the *A. racemosus* plant are some of the most attractive sources of new drugs and have been shown to produce promising results in the treatment of gastric ulcers and dyspepsia. This review will help in future to explore the medicinal potential of the phytoconstituents of shatavari.

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