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Asparagus racemosus: Many problems, one solution on its phytochemical and pharmacological potential

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Abstract
Asparagus racemosus is commonly called as satamuli, satavari, satawar found in low altitudes throughout India and belongs to family Liliaceae. It is an important ethnomedicinal plant of tropical and subtropical India. *Asparagus racemosus* has seen widely described to benefit an immune stimulant, antioxidant, anti-abortifacient (shatvarin-1), anti-dyspepsia, anti-tussive effects. It is also beneficial for treatment of liver cancer, stomach ulcers, excessive heat chronic fevers, kidney disorders, epilepsy, increases milk secretion in nursing mothers and regulates sexual behaviours. The major active phytoconstitutents to of *Asparagus racemosus* are asparagamine, racemosol, isoflavones, steroidal saponins, mucilage, Vitamins – A, B_1, B_2, C, E, Mg, P, Ca, Fe, and folic acid present in roots. *Asparagus racemosus* has been specially suggested of threatened abortion, galactagogue as well as restorative action as it is beneficial in women's complaints. This review summarizes the phytochemical pharmacogenetic and pharmacological aspects of *Asparagus racemosus*.

Keywords: Epilepsy, anti-dyspepsia, asparagamine, satavari, steroidal saponins

1. Introduction
Nature provides us a wide variety of medicinal plants having a great importance to cure different diseases of human being traditionally without having any side effect. *Asparagus racemosus* is a medicinal plant belonging to the family of Liliaceae (Mishra J. *et al*., 2014) [1]. Its effectiveness is based on hundreds of years of belief and observations. It is found in tropical and subtropical zones such as India, Asia, Africa, and Australia. Out of about 250000 flowering plants of the world, more than about 50000 are used for medicinal purposes. “Shatavari” is a medicinal plant which designated to the rejuvenate effect of the herb on the female reproductive organs (Kaaria L M *et al*., 2019) [2]. This is used in 67 ayurvedic preparations like Vidaryadi Ghritham, Vasishtha rasayanam, Shatamanamannadile, Shatavari ghritha, shatavaripanaka, Anthalia, Brahma rasyana, Dhanvantari etc. In Ayurveda, this unique herb is called as “Queen of herbs" because it promotes love and devotion (Pandey *et al*., 2021) [3]. *Asparagus racemosus* is one unique drugs in Ayurveda and effective in treating madhur vipakam, seet - veeryam, somrogam, chronic fever and internal heat (Karim S. *et al*., 2017) [4]. Charak Samhita and Ashtang Hridyam, the two main texts on ayurveda medicines uses *Asparagus racemosus* for the formula to treat women's health disorder. In Ancient times, the genus of Asparagus has been used as medicines due to its health benefit properties and soothing flavour (Daisy S. *et al*., 2021) [5]. The common name of this plant in different languages are in Odia; Sotabori; Hindi; Satavari; Sanskrit; Satamuli; Tamil: Tannivittan; Telugu: Pilli gaddalu; English: Wild asparagus; Gujarati: Satavari; Urdu: Satawar. *Asparagus racemosus* is a tuberous short root with much - branched spiny under shrub. The stems are sickle - shaped cladodes with scale leaves, armed with numerous recurved spines, small white flowers, and globose berries. Traditionally, all the parts of this plant are used for the treatment of different diseases (Devi P. *et al*., 2022) [6]. The fruits, leaves, tubers of the plant are used for treatment of headache, gastric troubles, diarrhoea, cough, rheumatism, diabetes, piles, gonorrhoea, and for increasing lactation. Pharmacological studies conducted in animal model have exhibited of *Asparagus racemosus* extract as an anti-anaphylactic, adaptogenic, anti-anaphylactic, antioxidant, antidiarrheal, antiulcer, antistress, antibacterial, antitussive, radio-protective agent and the ethanol extract of the steam caused a significant increase in insulin and reduce blood glucose (Alok S. *et al*., 2013 & Joon P *et al*., 2020) [7, 8]. The main objective of this review is to give a brief summery on the phytochemical and pharmacological potentials of *Asparagus racemosus*.

Fig 1: Stem and Root of *Asparagus racemosus*

Classification of *Asparagus racemosus*
Kingdom: Plantae
Phylum: Anthophyta
Class: Monocotyledons
Order: Liliales
Family: Liliaceae
Genus: Asparagus
Species: racemosus

Phytochemicals constituents of *Asparagus racemosus*
All phytochemicals are isolated from the plant kingdom. This phytochemical is dependent on the harvesting conditions of the plant as well as geographical locations. *Asparagus racemosus* is an important source of sapogenins and saponins, from its distinct parts. This plant contains steroidal saponins and racemofuran. The steroidal saponins, such as Shatavarin-VI, Shatavarin-VII, Shatavarin-VIII, Shatavarin-IX and Shatavarin - X, together with Shatavarin-I Shatavarin-IV, Shatavarin-V, immunoside and asparanin-A, have been isolated from the roots by RP-HPLC and other characterised by spectroscopic and spectrometric methods. There are three steroidal saponins which has been isolated from the methanolic extract of the fruits such as (i) (25S) - 5β - spirostan - 3β-01-3-0 {β - D - glucopyronsyl (1→6) - [α - L - rhamnopyranosyl (glucopyranosyl (1→4)]-β-D-gluco-Pyranoside} (racemoside A), (ii) [25S-5β - spirostan - 3β-01-3-0 -α-L - rhamnopyranosyl (1-6)] - β-D- glucopyranosyl (1-6)-β-D- glucopyrano - side (racemoside B) and (iii) (25S) -5β - spirostan - 3β-01-3- {α - L - rḥamnopyranosyl - (1-6)-[α- L-rhamnopyronosyl -(1-4)]-β-D- glucopyranoside (Racemoside - c). An isoflavone, 8 - methoxy - 5,6,4'-trihydroxyisoflavone-7-0-β-D- glucopyranoside and 9,10 Dihydro - 1,5, -dimethoxy - 8 - methyl - 2,7 - phenanthrene dio which has been isolated from this plant's root. The ethanol extract of the roots contains a cage – like alkaloid asparagamine-A. The flowers and roots of *Asparagus racemosus* contain quercetin-3-0-rutinoside (rutin) and quercetin-3-glucuronide has been isolated from leaves. A diosgenin, sapogenin has been isolated from the leaves of this plant (Singh *et al.*, 2018) [9].

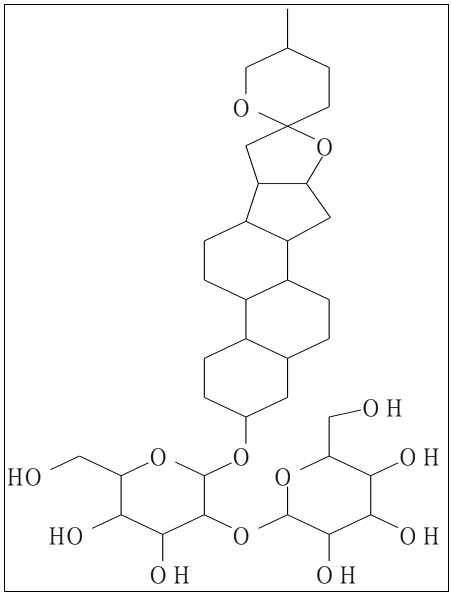

Fig 2: Structure of Schidigerasaponin D5 ($C_{39}H_{64}O_{13}$)

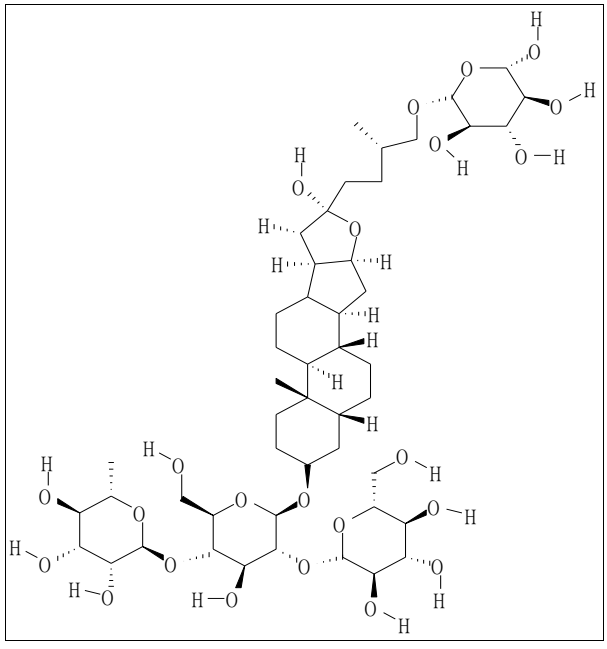

Fig 3: Structure of Shatavarin-I ($C_{51}H_{86}O_{23}$)

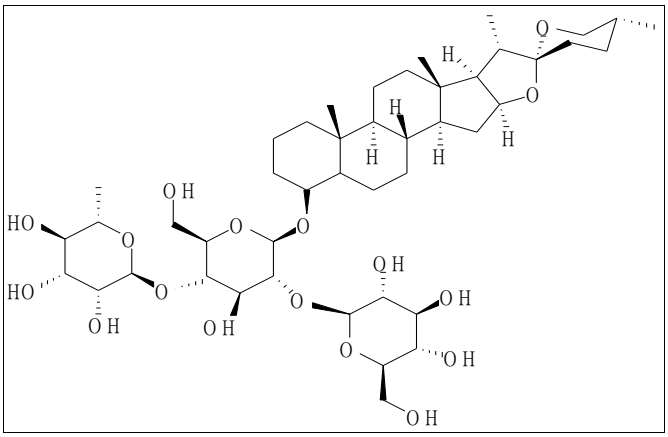

Fig 4: Structure of Shatavarin-IV ($C_{45}H_{74}O_{17}$)

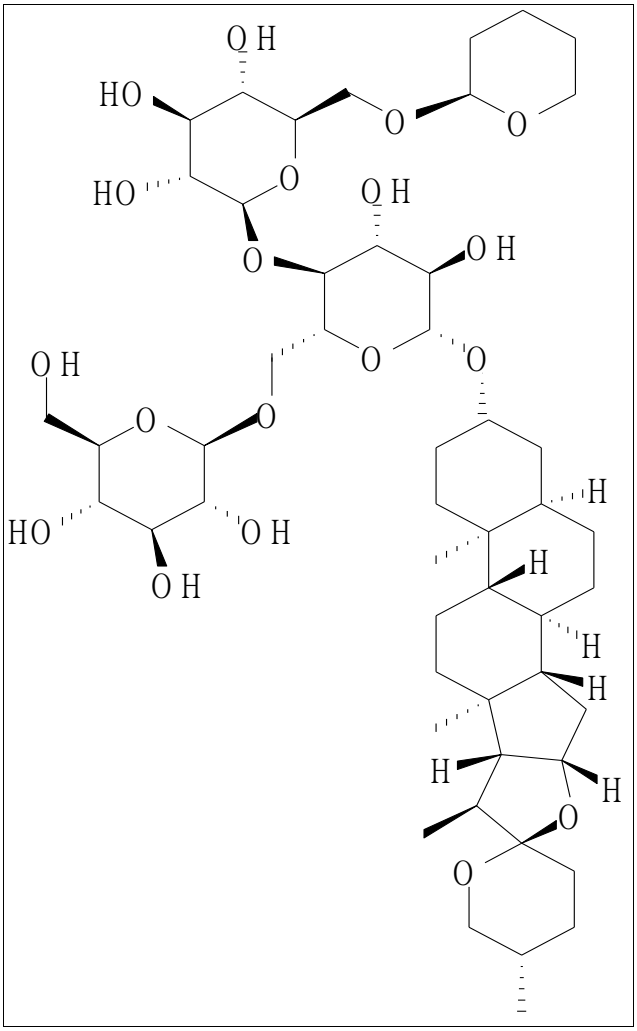

Fig 5: Structure of Racemoside-A [$C_{51}H_{84}O_{22}$]

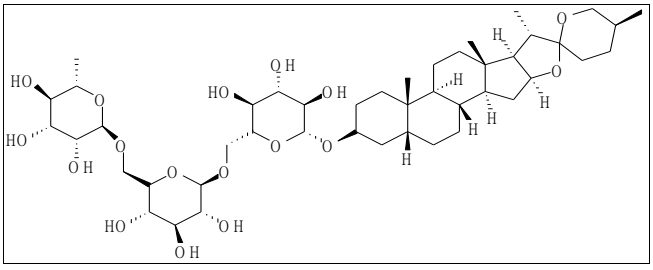

Fig 6: Structure of Racemoside-B [$C_{45}H_{74}O_{17}$]

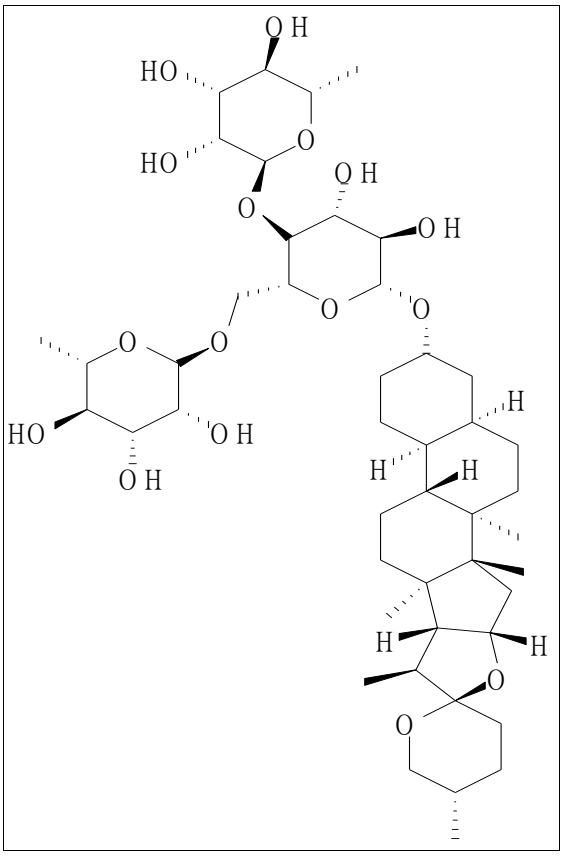

Fig 7: Structure of Racemoside-C [$C_{45}H_{74}O_{16}$]

Pharmacological activity

Various important pharmacological activities exhibited by *Asparagus racemosus* are represented bellow in Figure-8

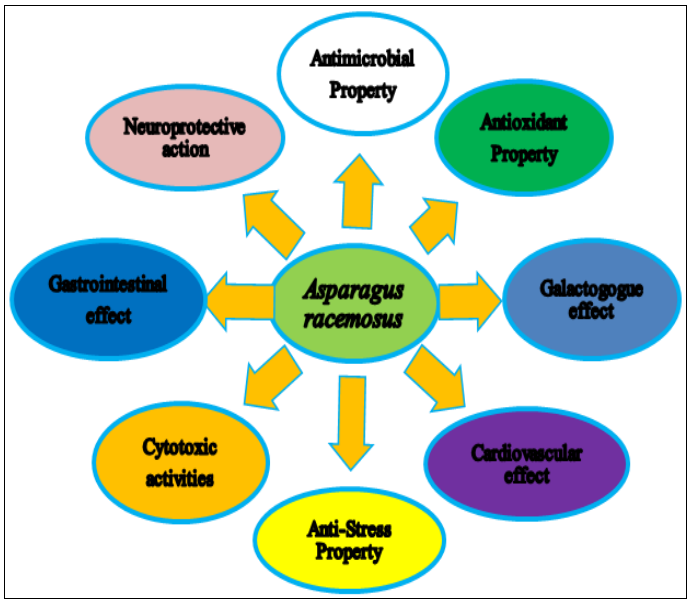

Fig 8: Pharmacological Activity of *Asparagus racemosus*

Anti - bacterial activity

The methanol extract of the *Asparagus racemosus* roots have shown as antibacterial potential under in-vitro condition against. *Bacillus subtilis*, *Pseudomonas putida*, *Salmonella typhimurium*, *vibrio cholerae*, *Escherichia coli*, Shigella dysenteriae, *Shigella flexneri* and *staphylococcus aureus* (Dharmvir A. *et al.*, 2014) [10].

Antineoplastic activity
Methanol/chloroform (1:1) extract of *Asparagus racemosus* roots has been shown to reduce the tumour incidence in female rats treated with 7, 12 dimethyl benza. This total action is suggested to be medicated by the help of mammotropic/lactogenic. *Asparagus racemosus* influences on normal as well as estrogen primed animals, which gives the mammary epithelium refractory to the carcinogen.

Antihepatotoxic activity
Alcoholic extract of *A. racemosus* roots has been reported to reduce the enhanced level of aspartate transminase, alanine transkinase and alkaline phosphate in CCl_4 induced hepatic damage in rats which is indicating antihepatotoxic potential of *Asparagus racemosus*.

Anti-ulcer activity
It is observed that 50% ethanolic extract of the whole plant of *Asparagus racemosus* is most effective in prevention of ulceration in case of rats (Vema *et al.* 2017) [18].

Galactagogue effect
A substance that enhances the lactation in humans and animals is known as galactagogue. It is used for secondary lactational failure. Patel *et al*. have reported this effect in buffaloes. 250 mg/kg of the aqueous extract of *Asparagus racemosus* root has been shown to increase both the milk yield of oestrogen printed rats and mammary lobuloaveolar tissue. This effect was assigned to the action of released corticosteroids or an increase in prolactin.

Antidiabetic effect
Mostly herbal medicines are mostly significant to treatment of diabetes. *Asparagus racemosus* roots have been shown to reduce blood glucose level in rats and rabbits. This root extract causes a stimulatory effect physiological insulinotropic pathways (Panduranga N. V. K.P. *et al.*, 2019) [12].

Antioxidant Effect
The moieties which are involved in the prevention of cell damage and many diseases. The methanolic extract of *Asparagus racemosus* root possess significant antioxidant properties when administered through the oral method. The enzymes like superoxidase, dismutase, ascorbic acid and catalase increase with reduction in the lipid peroxidation. The antioxidant properties were revealed due to the presence of Isoflavons. (Singh M & Sharma V., 2016; Tripathi Y C. *et al*., 2015 & Kumar S. *et al.* 2020) [13, 14, 15].

Cardio protective rate activity
The atherosclerosis and cardiovascular diseases are developed due to increase in the serum cholesterol specially LDL cholesterol. The release of free radical has been developed of coronary artery disease. All studies reveal a significant hypocholesterolemic role of *A. racemosus* extract methanolic root extract of *Asparagus racemosus* supplements are potential components in decreasing lipid peroxidation. This extract shows a decrease in low density lipoproteins, low - density lipoproteins and triacylglycerol levels on blood (Vishwakarma P. *et al.*, 2019) [16]

Antiprotozoal activity
The solution of the crude alcoholic extract of the roots of *Asparagus racemosus* has been shown an inhibitory effect of the growth of *Entamoeba histolytica in vitro*.

Antitussive effect
Methanolic extract of roots (Dose of 200 and 400 mg/kg P.O caused to be visible an antitussive activity on SO_2 - induce Cough in mice. The 40% and 58.5% cough inhibition respectively, was comparable to that of 10-20 mg/kg of codeine phosphate, where the inhibition observed 36%, and 554%, respectively.

Adaptogenic activity
The extract of the whole plant of *Asparagus racemosus* gave orally to animals which was exposed to biological, physical, and chemical stress gave positive response. So, this extract reversed effects of cisplantin on normalised cisplatin induced intestinal hypermotility and gastric emptying. The herbal formulation of *A. racemosus* with name “Siotone” is unpredictable, active against chronic, but glucose metabolism, depression, suppressed male sexual behaviour immunosuppression and cognitive dysfunction in albino rats. The study about “Siotone" had significant (p<0.05) adaptogenic activity. It was capable to reverse chronic stress induced biochemical, behavioural perturbations and physiological, and which was comparable to Panax ginseng, a reputed rasayana herb.

Effect on Uterus
Methanolic extracts of *Asparagus racemosus* can be used as uterine sedative. *Asparagus racemosus* roots extract has been responsible for block of guinea pig, contraction of rat and rabbit's uteri induced by oxytocin. The roots of *Asparagus racemosus* fight against increases libido, female infertility, increases lactation, reduces, or prevents abortion, decreases inflammation of sex organs, and improves the hormonal balance after postpartum.

Anti - inflammatory Activity
The administration of 200 mg/kg (i.p) accelerating to reductions in tissue weight, skin thickness, inflammatory cytokine production, various histopathological and neutrophil mediated myeloperoxidase activity. Angiotensin changing enzyme have effective to reducing inflammatory damage, induced by a significant inhibition of vascular permeability induced by acetic acid and chronic TPA exposure.

Anti-tumour Activity
Cancer is the second largest killer in the world. As the diagnosis of cancer is possible but the survival rate is low till today. *Asparagus racemosus* is a widely distributed medicinal plant having anti-tumour activity (Benal P B. *et al.*, 2020) [17].

Conclusion
A different part of *Asparagus racemosus* has been broadly studied for ethnomedicinal properties. The extracts of *A. racemosus* has proved to possess phytochemical and pharmacological potential. *Asparagus racemosus* is an important etnomedicinal plant and it is used in medicines, like Sidha, Unani, and Ayurveda. More considerable work has been done to explore medicinal applications and biological activity of the *A. racemosus* plant, still there is available countless pharmacological applications, which needs to be explored. This plant has various pharmacological applications such as antibacterial, antineoplastic, and antihepatotoxic, galactagogue, antidiabetic, antioxidant, Cardio - protective, antiprotozoal, antitussive, adoptogenic, effect on uterus and

anti-inflammatory activity. The major studies of *Asparagus racemosus* was represented using extracts of the plant; still the different active principle involved behind these more activities needs to be explored, more keen interest would create farmer to undertake commercial cultivation of *Asparagus racemosus*. So, curbing the over exploitation of *Asparagus racemosus* plant on the wild and thereby complement the conservation process various studies have been conducted on *Asparagus racemosus* parts of plant and this plant has developed as drug by different pharmaceutical industries. A systematic as well as detailed study is required for cataloguing, identification, classification, and documentation of plants, which may promote traditional knowledge of the medicinal herbal plant.

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