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SHATAVARI (ASPARAGUS RACEMOSUS WILD): A REVIEW ONITS CULTIVATION, MORPHOLOGY, BIOLOGICAL ACTIVITIES & PHARMACOLOGICAL IMPORTANCE

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ABSTRACT :-

Asparagus racemosus, traditionally known as shatavari means "Who possesses a hundred husbands or acceptable to many,Family Liliaceae.Shatavari found at low altitude throught the India. Dried root of plant are used as drug.Its content sapogenin, sarsa-sapogenin, flavonoids (kaempferol, quercetin, and rutin) and poly phenols is the precursor of many pharmacologically active steroid .It is use medicine like in Ayurveda, Unani & Siddha. In Ayurveda it considered as female tonic and widely in disease including dysentery, in diabetics retinopathy, inflammations, tumor, bronchitis, nervous disorder, hyperacidity, certain infectious diseases, nuropathy, spasm, chronic fever, and rheumatism. It is also beificial in female infertility to increases libido and cures inflammation of sexual organs, Enhance folliculogenesis and ovulation, prepares the womb for conception, prevents miscarriages, acts as post partum tonic by increasing lactation and normalizing the uterus and the changing hormons. Its used also indicate in leucorrhoea and menorrhagia. It has also been identified as one of the drug to control the symptoms of AIDS. It also promotes maternal health, and fuxssily used as a galactagogue. Shatavari is the main Ayurvedic rejuvenative tinic for the females,as is Withanin for the males. Its beneficial uses in correcting menstrual irregularities and they are prescribed by ayurvedic physicians tocorrect menstrual irregularities with products available in the markets.

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.

1. 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 Chinaand India, but it is mainly cultivated in India.[1]

Classification :- Kingdom :- Plantae Order :- Asparagales Family:- Asparagaceae
Sub family :- AsparagoideaeGenus :- *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

2. 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 regulatingcardiac disorders and hypertension.[6]
It is extensively used in male genital dysfunctions, oligospermia, spermatogenic irregularities and othermale 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 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.

3. 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.[19] According to Indian pharmacopoeia, *A. racemosus* contains not less than 0.1 per cent of Shatavarin IV, as calculated on the dried weight basis. 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.[20] 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 oral 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 cellsround 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.[21] 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[22] 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.[23] 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.[24] The roots are ground, they have a gritty texture and a light brown color. Light (sandy), medium (loamy), and heavy (clay) soil are preferred by the plant. Black, rich, well-drained soil isidealfor growing A. *racemosus*, while it may also be grown in loose, medium-black soil. Crops mostly require a tropical, hot climate and little irrigation so as to avoid overwatering. In May orJune, raised beds that are roughly 3m long are harvested. The months of July and August are when transplanting takes place. In the month of July, it releases little, monosexual, white blooms.

1. **Irrigation Method**
2. **Intercultural Method**
3. **Harvesting Method**

Isolation of Shatavari :-

Peeling → Drying → Sorting → Grading → Packing

4. BIOLOGICAL ACTIVITIES

Nutritional studies demonstrated that *Asparagus* is a low- calorie source of folate andpotassium. The plant is widely used in about 64 Ayurvedic formulations which include traditional formulations such as 'Shatavari Kalpa', 'Phalaghrita', 'Vishnu taila'.[25] 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 beendemonstrated for its antioxidant effect.[26] 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 bea 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 ofprotein thiols and inactivation of superoxide dismutase.[27]

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 theroots utilizing three dose vials 800 mg/kg, 1600 mg/kg and 3200 mg/kg for its diuretic activity in comparison with standard drug (furosemide) and control (normal saline) ratsafter performing acute toxicity tests. . The extract demonstrated diuretic activity at a 3200 mg/kg dose without any acute toxicity.[28]

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 theextracts 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 throughinteraction with adrenergic, dopaminergic, serotonergic and GABAergic systems (Gamma aminobutyric acid).[29] Experiments have been performed on rats using the methanolic extract and subjected to forced swim test (FST), learned helplessness test (LH) and it has been found that the extract decreases immobility in the FST and increases avoidance response in LH indicating antidepressant activity. Behavioural experiments were conducted, extract administered increased the number of head twitches produced by 5-HT (5- hydroxy tryptamine), increased clonidine- inducedaggressive behaviour and it was concluded that the methanolic extract has a significant antidepressant activity mediated via serotonergic, noradrenergic systems and precipitation of antioxidant defences.[30]

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, clones and also the duration of stupor phase. There was a prolonged onsetof the tonic clonic seizure induced by pentylenetetrazol in the groups treated with methanolic and aqueous extracts and mechanism behind the activity was GABAergic.[31]

5. **Antitussive effect:** The methanolic extract of roots has been reported to possess antitussive. Antitussive effect produced was dose dependent for both extracts as wellas standard drug which further supported the claims put forward by traditional medicine practitioners about the usefulness of *A. racemosus* in the treatment of cough.[32]

6. **Antileshmanial 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.[33] 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 beentested 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 IC_{50} value of 29µg/mL.[34]

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 disordersare 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 sapogenin 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.[36]

5. PHARMACOLOGICAL IMPORTANCE

1. **Hepatoprotective Activity**: of glutathione levels in cases with isoniazid toxicity upon extract administration was observed.[37] Hepatoprotective activity was resultant ofinhibited production of free radicals, acting as a scavenger and reducing the free radical generation via inhibition of hepatic CYP2E1 activity.[65,11] In paracetamolinduced 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.[38]

2. **Antibacterial activity:** The root extracts of *A. racemosus* have been studied for antibacterial activityemploying standard cylinder method. Microbes used were *Bacillus subtilis, Staphylococcus aureus.*[39] *Staphylococcus werneri, Pseudomonas aeruginosa* and *Escherichia coli, Proteus mirabilis, Kleibsella pneumonia, 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 sidhghrit) were prescribed in the cases of threatened abortions.[40] The observed activity was due to the Shatavarin- I.[41] (7). *In vivo* effect of shatavarin IV (12) i.e. saponin A4 on the uterine muscles was similar to the estrogen.[42] The polycyclic alkaloid asparagamine A (28) have been reported to possess an anti-oxytocic action.[43] and showing an anti abortifacient affect.

2. **Antenatal tonic:** A capsule Sujat containing *A. racemosus* extract, There was reductionin the incidence of pregnancy induced hypertension (PIH). PGI2 and NO (nitric oxide) are the important vasodilators; a deficiency of these can lead to PIH.

3. **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.[44] 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.[45] 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.[46]

4. **Anti-diarrheal activity:** in today era, diarrhoea is the reason for three-fourth of infant and childhood mortality.[47] The use of oral dehydration therapy reduced mortality but chronic diarrhoea is still a life-threatening problem in the regions where malnutrition isa regular co-existing andcomplication factor. The extracts of *A. racemosus* were evaluated for its antidiarrheal activity. The ethanolic and aqueous extracts have been shown to possess inhibitory activity against gastrointestinal tract motility.[48]

5. **Anticandidal activity:** Experimental findings suggested that methanol extracts possessed high anticandidal activity against different *Candida* species.[49]

6. **Cardio protective effects:** formulationmanufactured 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 wasan observed significant increase in high- density lipoprotein cholesterol levels.[50] 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.[51]

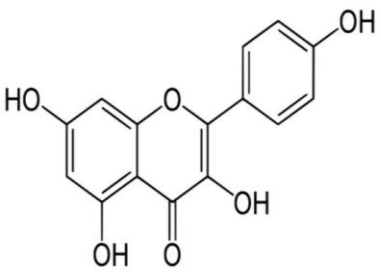
7. **Neurodegenerative disorders:** formulation consisting of standardized extracts has been used asanti-stress agent to ease the various aspects of stress related disorders. The extract showed normalization in the elevated levels of NA (nor-epinephrine), DA (dopamine), 5HT (5-hydroxy tryptamine) concentrations, which were increased by chronic electroshock stress. Decrease in neurochemical levels in the brain indicates the effectiveness of the formulation in neurological disorders.[52] 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.[53]

8. **Anti-cancer property:** The root extract was shown to have a protective effect in the mammary cell carcinoma.[54] 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 potentanti-cancer activity.[55]

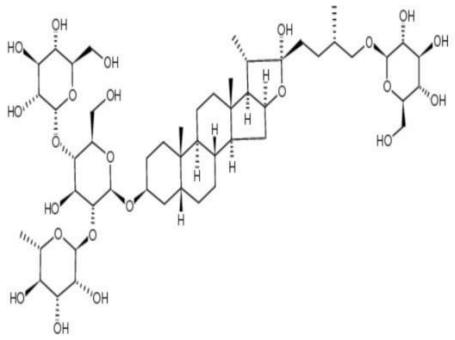
6. PHYTOCHEMICALS [56]

A. racemosus consists of a wide verity of molecules in which the major chemical constituent is steriodal saponins along with alkaloids, flavonides, dihydrophenanthrene derivatives, furan derivatives, and volatile constituents. The root of plantcontains major constituents as steroidal saponins namely Shatavarin I- Shatavarin VI. Shatavarin IV contains tannins, alkaloids, protein. It is a glycoside of Sarsasapogenin having one glucose and two rhamnose moieties. The roots also contain a Polycyclic Alkaloid Asparagamine A, Isoflavones are 8- methoxy-5, 6, 4-trihydroxy isoflavone-7- O-beta-D- glucopuranoside, A furan compound include Racemofuran, Sterols such as Sitosterol, 4, 6-dihydroxy-2-O (2- hydroxyl isobutyl) benzaldehyde, A cyclic hydrocarbon include Racemosol and Trace minerals such as copper, zinc, cobalt with magnesium, calcium are reported in roots of plant. The constituents Kaempferol with Sarsasapogenin is isolated from wood part of plant. Ketone and Aldehyde components are obtained from shoot part. The flowers and fruits contains Quercetin, Hyperoside and Rutin component. The constituent flavonoids are Quercetin-3- glucuronide is isolated from leaves.

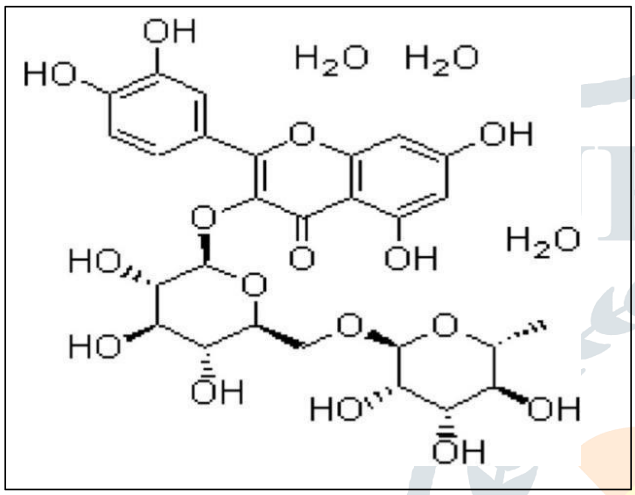
STRUCTURE OF CHEMICAL CONSTITUENTS PRESENT IN PLANT:



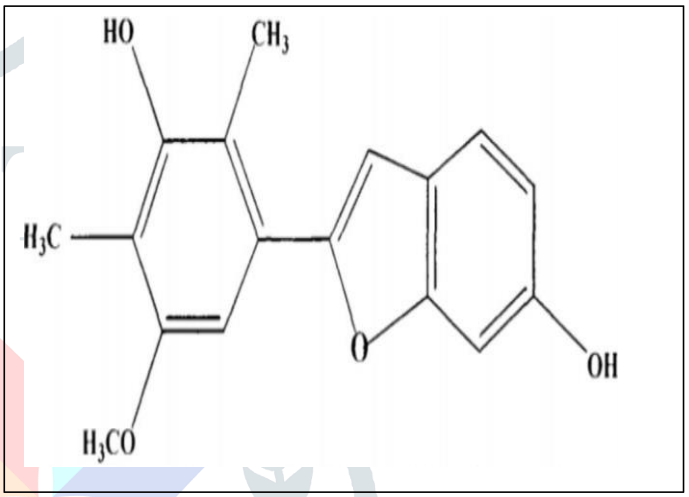
Kaempferol



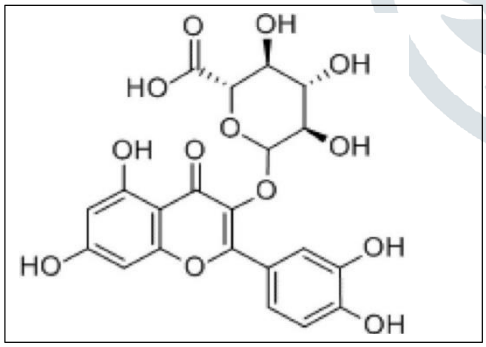
Shatavarin VI



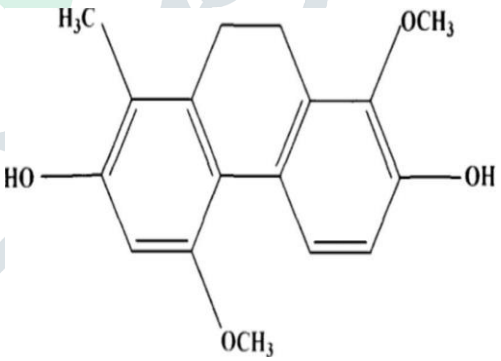
Rutin



Racemosol



Quercetin-3-glucuronide



Racimofuran

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, neuro degenerative. 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 farmersto undertake commercial cultivation of *A. racemosus.*

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