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RESEARCH ARTICLE

ASPARAGUS RACEMOSUS: FOR MEDICINAL USES & PHARMACOLOGICAL ACTIONS.

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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 throughout india.the dried root of plant are used as drug. Its content sapogenin, sarsasapogenins, flavonoids (kaempferol, quercetin , and rutin) and poly phenols is the precursor of many pharmacologically active steroids. It is used as medicine like in Ayurveda, Unani & Siddha. In Ayurveda it is considered as a female tonic and widely used in diseases including dysentery, in diabetic retinopathy, inflammations, tumor, bronchitis, nervous disorder, hyperacidity, certain infectious diseases, neuropathy, conjunctivitis, spasm, chronic fevers, and rheumatism. It is also beneficial in female infertility to increases libido and cures inflammation of sexual organs, enhances 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 hormones. Its used also indicate in leucorrhoea and menorrhagia. It has also been identified as one of the drug to controle the symptoms of AIDS. It also promotes maternal health, and fussily used as a galactagogue. Shatavari is the main Ayurvedic rejuvenative tonic for the females, as is Withania for the males. Its beneficial uses in correcting menstrual irregularities and they are prescribed by ayurvedic physicians to correct menstrual irregularities with products available in the markets.

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Introduction:-

Traditionally, this plant based on medicines have been used, Medicinal plants occupy an important position in the socio-cultural, spiritual and medicinal arena of India and in many countries of Asia, Africa and East Europea are needs for primary health care. Out of about 250000 flowering plants of the world more than 50000 are used for medicinal purposes. *Asparagus racemosus* (family- Asparagaceae) also known as "Shatavari, means "she who possesses a hundred husbands" indicates that this herb is highly effective in problems related with female reproductive system. Charak Samhita written by Charak and Ashtang Hridayam written by Vagbhata, the two main texts on Ayurvedic medicines, lists *Asparagus racemosus* as part of the formulas to treat disorders affecting women's health (Thorn 2000). In modern Ayurvedic practices the roots of plant are considered to be effective as antispasmodic, appetizer, stomach tonic, aphrodisiac, galactagogue, astringent, antidiarrhoeal, antidiysentiric, laxative, anticancer, anti-inflammatory, blood purifier, antitubercular, antiepileptic and also in night blindness, kidney problems and in throat complaints (Garde, & Sarth 1970). Further, it is mentioned as medhya- the plants which increase intelligence and promote learning and memory. The rejuvenator herbs which improves health by increasing immunity, vitality and resistance, imparting longevity as well as protection against stress (Srikantha, & Vagbhata 1997). Among approximately 300 species distributed around the world, 22 species of *Asparagus* have

been recorded in India where, *A. racemosus* is most commonly used as a medicinal plant in traditional medicine (Bopana & Saxena, 2007).



Fig 1. A Plant of *Asparagus racemosus*

Classification (Thomson, 2002)

| | | |
|-----------------------|---|---------------------------|
| Kingdom | : | Plantae |
| Division | : | Magnoliophyta |
| Class | : | Liliopsida |
| Order | : | Asparagales |
| Family | : | Asparagaceae, Liliaceae |
| Genus | : | Asparagus |
| Species | : | Racemosus |
| Botanical name | : | Asparagus racemosus Willd |

Regional name (Thomson, 2002)

| | | |
|-----------------------|---|--|
| Hindi | : | Satavari, Satawar or Satmuli |
| Sanskrit | : | Satavari |
| Bengali | : | Shatamuli |
| Marathi | : | Shatavari, Shatmuli |
| Gujarati | : | Satawari |
| Telegu | : | Toala-gaddalu, Pilli-gaddalu; |
| Tamil | : | Shimaishadavari, Thanner Vittan Kizhango, Inli-chedi |
| Malayalam | : | Chatavali |
| Kannada | : | Majjigegadde, Aheruballi |
| Kumaon | : | Kairuwa |
| Madhya Pradesh | : | Narbodh, Satmooli |
| Rajasthan | : | Norkanto, Satawar |

Territory

It is territory common at low altitudes in shadow and in tropical climates throughout Asia, Australia and Africa. Out of several species of *Asparagus* grown in India, *A. racemosus* is most commonly used in home-grown medicine (Simon 1997).

Morphology:-**Macroscopy:-**

The air dried roots are brown in color, tuberous, elongated, and tapering at both the ends up to 30-100 cm long. The fresh roots are fleshy and white in color while on drying it become shrunked longitudinal ridges appeared and the color turned light brown. Outer surface of the fresh root is soft and contains epidermal hairs. Taste is mucilaginous, fracture brittle. The powder drug swells on moistening with water. Roots are cylindrical, fleshy tuberous straight or slightly curved, tapering towards the base & swollen in the middle, white buff color and 5-15cm in length 1-2 cm diameter

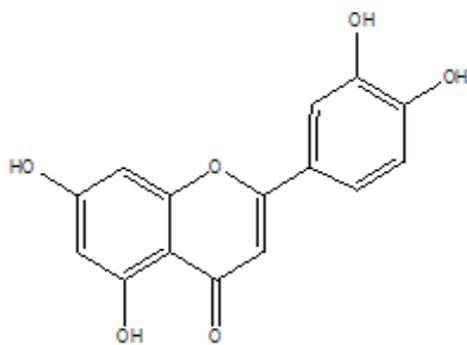
Microscopy:-

Transverse section of the root is circular or elliptical; periderm is composed of 5-6 layers of compact cells, tangentially elongated thin walled phloem. About 2-3 peripheral layers of cork cells followed by a single layer of phelloderm. The phelloderm is followed by 6-7 layers of cortical cells. Vascular bundles are arranged in the center forming a circular ring. Protoxylems are arranged toward the center; while the metaxylem toward the outer side. There is a wide zone of secondary phloem composed of sieve tubes, companion cells and phloem parenchyma. A wide zone of secondary xylem, which is composed of vessels, tracheids and xylem parenchyma, follows secondary phloem. The epidermal layers contain numerous epidermal hairs (Anonymous, 2003).

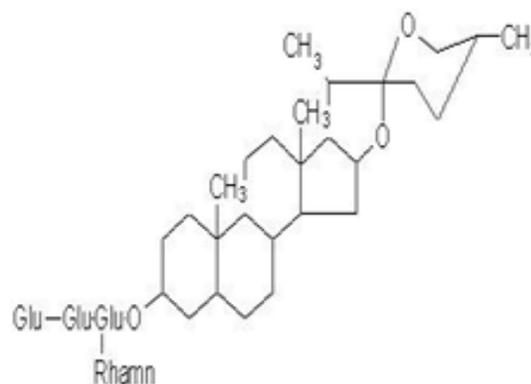
Bioactive constituents:-

Shatavari possess a wide range of phytochemical constituent which are mentioned below.

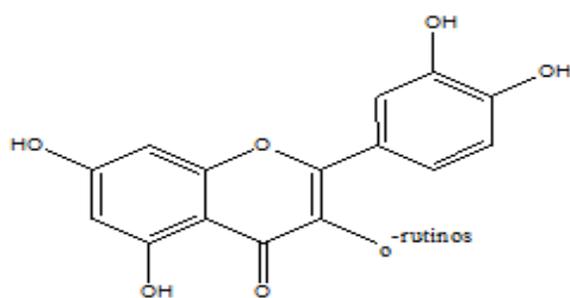
1. Shatavari roots contain 4 steroids saponin known as shatvarins. Shatvarin I to VI are present. Shatvarin I is the major glycoside with 3-glucose and rhamnose moieties attached to sarsapogenin, whereas in sahatvarin –IV two glucose & one rhamnose moieties attached (Joshi et al., 1988, Gaitonde et al., 1969, Nair et al., 1969).
2. Recently, Shatavarin V, Aspariginins, curillins, Asparosides, Curillosides have also been reported. (Patricia et al., 2006).
3. Oligospirostanoside referred to as Immunoside. (Handa et al., 2003).
4. Polycyclic alkaloid- Aspargamine A, a cage type pyrrolizidine alkaloid (Sekine et al., 1997).
5. Isoflavones - 8-methoxy- 5, 6, 4-trihydroxy isoflavone-7-O-beta-D-glucopyranoside (Saxena et al., 2001, Sekine et al., 1997). A cyclic hydrocarbon-Racemosol (Wiboonpun et al., 2004).
6. Furan compound- Racemofuran (Kamat et al., 2000).
7. Carbohydrates- Polysaccharides, mucilage (Sharma 1981).
8. Flavanoids- Glycosides of quercetin, rutin and hyperoside are present in flower and fruits (Singh, 1991).
9. Sterols- Roots also contain sitosterol, benzaldehyde and undecanyl cetanoate (Choudhary, & Kar, 1992).
10. Trace minerals - are found in roots-zinc, manganese, copper, cobalt along with calcium, magnesium, potassium zinc and selenium (Mohanta et al., 2003, Ahmad et al., 1991).
11. Kaepfrol- Kaepfrol along with Sarsapogenin from woody portions of tuberous roots could be isolated (Subramanian, & Nair, 1968).
12. Miscellaneous- Essential fatty acids- Gamma Linoleic acids, Vitamin A, Diosgenin, quercetin 3-glucourbnides (Tambvekar, 1985).



Quercetin



Shatavari



Rutin

Substitutes and adulterants:-

It is reported that in Indian markets apart from *Asparagus racemosus*, the roots of *Asparagus sarmentosus* Linn, *Asparagus filicinus* Ham, *Asparagus curillus* Ham, and *Asparagus sprengeri* Regel are also mortal probably sold in the name of Shatavari (Sharma et al., 2000).

Pharmacological activities:-

Antidepressant activity:-

Methanolic extract of *Asparagus racemosus* significant antidepressant-like activity almost certainly by inhibiting MAO-A and MAO-B; and through interaction with adrenergic, dopaminergic, serotonergic and GABAergic systems (Dhingra, & Kumar, 2007).

Antitussive activity:-

Methanolic extract of roots shatavari show significant antitussive activity on sulphur dioxide- induce cough in mice. The cough inhibition of 40% and 58.5%, respectively, was comparable to that of 10-20mg/kg of codeine phosphate observed 36% and 55.4%, respectively (Subramanian & Nair, 1968).

Antisecretory activity:-

Asparagus racemosus causes an inhibitory effect on release of gastric hydrochloric acid and protects gastric mucosal damage and found to be an effective antiulcerogenic agent (Bhatnagar, & Sisodia, 2006).

Adaptogenic activity:-

The aqueous extract of *Asparagus racemosus* reversed the effects of cisplatin on gastric emptying and also normalized cisplatin-induced intestinal hyper motility (Regh et al., 1989).

Antidiarrhoeal and analgesic activity:-

Ethanol extract of whole plant *Asparagus racemosus* have Anti-diarrhoeal and Analgesic properties (Venkatesan et al., 2005). In another study the effect of aqueous and ethanol extract of *Asparagus racemosus* for its antidiarrhoeal potential against experimental models of diarrhoea in Albino *Wistar* rats (Karmakar et al., 2012).

Antiprotozoal activity:-

An aqueous solution of the crude alcoholic extract of the roots exhibited an inhibitory effect of the growth of *Entamoeba histolytica* (Roy et al., 1971).

Antibacterial activity:-

Methanol extract of the roots of *Asparagus racemosus* have antibacterial efficacy against *Escherichia coli*, *Shigella sonnei*, *Shigella dysenteriae*, *Shigella flexneri*, *Vibrio cholerae*, *Salmonella typhi*, *Salmonella typhimurium*, *Bacillus subtilis*, *Pseudomonas putida* and *Staphylococcus aureus* (Ravishankar et al., 2012), and also show the spectrum of inhibition on *Staphylococcus aureus*, *Bacillus subtilis*, *Pseudomonas putida*, *Staphylococcus wernerii*, *Proteus mirabilis*, *Pseudomonas aeruginosa* (Mandal et al., 2012).

Gastrointestinal activity:-

The powdered dried root of *A. racemosus* promote gastric emptying in healthy volunteers and its action comparable with that of the synthetic dopamine antagonist metoclopramide (Dalvi et al., 1990). In Ayurveda, *A. racemosus* use for the treatment of ulcerative disorder of stomach, and the juice of fresh root of *A. racemosus* have definite curative effect in patients of duodenal ulcers (Kishore et al., 1980). *A. racemosus* along with *Terminalia chebula* has been protecting gastric mucosa against pentagastrin and carbachol induce ulcer by reducing severity of ulceration (Dahanukar et al., 1986). Its cause contraction of smooth muscles without affecting peristaltic movement. These actions were found to be similar to that of acetylcholine and were blocked by atropine (Jetmalani et al., 1967).

Anti-inflammatory activity:-

Administration of 200 mg/kg (i.p.) leading to substantial reductions in skin thickness, tissue weight and also inflammatory cytokine production, neutrophil-mediated myeloperoxidase activity, and various histopathological indicators. Additionally Angiotensin converting enzyme have effective to reducing inflammatory damage induced by chronic TPA exposure and a significant inhibition of vascular permeability induced by acetic acid (Lee et al., 2009).

Protects against amnesia enhances memory activity:-

Asparagus racemosus inhibited acetylcholinesterase enzyme in specific brain regions (prefrontal cortex, hippocampus and hypothalamus). Thus it shows nootropic and anti-amnesic activities in the models tested and these effects may be mediated through augmentation of cholinergic system due to its anti-cholinesterase activity and *A. racemosus* extract verified that significant decrease in latency time during retention trials. Hippocampal regions associated with the learning and memory functions and show dose dependent increase in acetylcholinesterase activity in Carbonic anhydrase I with *A. racemosus* (Ojha et al., 2010, Sharma et al., 2010).

Aphrodisiac activity:-

Lyophilized aqueous extracts roots of *A. racemosus* have sexual behavioral effects in male albino rats. Administration of the aqueous extracts have pronounced anabolic effect in treated animals as evidenced by weight gains in body and reproductive organs. There was a significant variation in the sexual behavior of animals as reflected by reduction of mount latency, ejaculation latency, post ejaculatory latency, intromission latency. Penile erections are also considerably enhanced. Reduced hesitation time, also indicated an improvement in sexual behavior of extract treated animals. The observed effects appear to be the testosterone-like effects of the extracts. Nitric oxide based intervention may also be involved as observable from the improved penile erection (Thakur et al., 2009).

Anti-hepatocarcinogenesis:-

Histopathological study of hepatic tissues, treated with diethyl nitrosamine (DEN) and aqueous extract of the roots of *A. racemosus* prevented the incidence of hepatocarcinogenesis (Agrawal et al., 2008).

Antilithiatic effects:-

Ethanol extract of *A. racemosus* have inhibitory potential on lithiasis (stone formation), induced by oral administration of 0.75% ethylene glycolated water to adult male albino *Wister* rats for 28 days (Christina et al., 2005).

Anti-stress activity:-

A. racemosus are used in Indian traditional medicine system for improving the general state of health and for stress-related immune disorders and these plants also beneficial in the management of stress and inflammatory conditions. The effects of the methanol and aqueous extracts of the tuberous roots of these plants were examined in an experimental mouse stress model. The extracts show an inhibitory effect on pro-inflammatory cytokines, namely interleukin 1β and tumor necrosis factor α , and on the production of nitric oxide in mouse macrophage cells RAW 264.7 stimulated by lipopolysaccharide in vitro (Kanwar et al., 2010, Joshi et al., 2012).

Galactogogue activity:-

Alcoholic extract of *Asparagus racemosus* have a significant effect on lactating mother to increase milk production and have been observed along with increased growth of the mammary glands, alveolar tissues and acini (Sabins et al., 1968). The growth of lobuloalveolar tissue and milk secretion in the estrogen primed rats was thought to be due to the action of released corticoids or prolactin (Meites et al., 1962).

Neurodegenerative disorders activity:-

In Alzheimer's and Parkinson's diseases, excitotoxicity and oxidative stress are the major mechanisms of neuronal cell death. Therefore, to combat neurodegenerative disorders, there is a need for a compound that can retard or reverse this neuronal damage. *Asparagus racemosus* is a well-known nervine tonic in the Ayurvedic system of medicine. Parihar and Hemnani (2004) conducted a study to investigate the potential of methanolic extract of *Asparagus racemosus* roots against kainic acid (KA)-induced hippocampal and striatal neuronal damage in mice. Intra-hippocampal and intra-striatal injections of KA to anesthetized mice resulted in the production of excitotoxic lesions in the brain. After KA injection, impairment of hippocampus and striatal regions of brain was observed accompanied by increased lipid peroxidation, increased protein carbonyl content, decreased glutathione peroxidase (GPx) activity and reduced glutathione hormone (GSH) content. GSH is an important antioxidant which acts as a nucleophilic scavenger of toxic compounds and as a substrate in the GPx-mediated destruction of hydroperoxides which would otherwise accumulate to toxic levels in brain tissues. The mice treated with *Asparagus racemosus* extract showed an enhancement in GPx activity and GSH content, and reduction in membranous lipid peroxidation and protein carbonyl. They concluded that the plant extract plays the role of an antioxidant by attenuating free radical induced oxidative damage (Bhattacharya et al., 2002).

Cardio protective activity:-

Increase in serum lipid levels especially cholesterol along with the generation of reactive oxygen species are the major reasons for the development of coronary artery disease and atherosclerosis. 'Abana', a herbo-mineral formulation containing 10 mg *Asparagus racemosus* extract per tablet, was found to have significant hypocholesterolaemic effect in rats and therefore established a potential for use as a cardio-protective agent (Khanna et al., 1991). They found that the total cholesterol, phospholipids and triglyceride levels were significantly lower as against the control. Since 'Abana' is a polyherbal formulation, further found to be exact role that the *Asparagus racemosus* component plays in the hypolipidaemic action. *Asparagus racemosus* has also been investigated for the reduction of cholesterol levels in hypercholesteremic rats by (Visavadiya and Narasimhacharya, (2005). The *Asparagus racemosus* root powder supplements decreased lipid peroxidation and caused a dose-dependent reduction in lipid profiles. The total lipids, total cholesterol and triglycerides in plasma and liver as well as plasma LDL (low-density lipoprotein) and VLDL (very low-density lipoprotein)-cholesterol decrease. Though it can be hypothesized that the hypercholesteremia is alleviated by decreasing exogenous cholesterol absorption and increasing conversion of endogenous cholesterol to bile acid.

Medicinal uses:-

Asparagus racemosus is mainly recommended in ayurveda for prevention and treatment of gastric ulcers, dyspepsia and as a galactogogue besides its action in nervous disorders, inflammation, liver diseases and certain infectious diseases⁹. The methanol extract of its root exhibits anti-bacterial property against infectious diseases due to presence of the constituent 9, 10 dihydrophenanthrene. It is an important traditional digestive tonic for diarrhea, dysentery, dyspepsia and indigestion. Alcoholic and aqueous extracts of *Asparagus racemosus* root has

hepatoprotective, antimicrobial and immuno-modulatory property against pathogenic bacteria, helminthes, virus, fungi and protozoa (Mandal et al., 2000). Systemic administration of alcoholic extract of *Asparagus racemosus* in weaning rats increases weight of the mammary glands, inhibits involution of lobulo-alveolar tissue and maintains milk secretion due to the action of released corticoids and prolactin (Sabins et al., 1968). A significant increase in milk yield, after feeding lactate through increased growth of mammary glands, alveolar tissues and acini by galactogogue effect (Narendranath et al., 1986). Root is used in Diarrhea as well as in cases of chronic colic and dysentery. Root boiled with some bland oil, is used in various skin diseases, root is boiled in milk and the milk is administered to Shatavari (this is an Indian word meaning a woman who has a hundred husbands) is the most important herb in ayurvedic medicine for dealing with problems connected women's fertility. It is taken internally in the treatment of infertility, loss of libido, threatened miscarriage, menopausal problems, stomach ulcer, hyperacidity and bronchial infection. Externally it is used to treat stiffness in the joints (Bown, 1995). The whole plant is used in the treatment of rheumatism, diabetes and brain complaints. It is also used in management of behavioral disorder and minimal brain dysfunction (Sheth et al., 1991). The rhizome is a soothing tonic that acts mainly on the circulatory, digestive, respiratory and female reproductive organs. The root is alterative, antispasmodic, aphrodisiac, demulcent, diuretic, galactogogue and refrigerants (Chopra et al., 1986).

Marketed formulation:-

Shatavari kalpa, Eranda paka, Bhrihachagaladya Puga khanda, ghrita, Phalaghrita, Narayana taila, Shatavaryadi ghrita, Garbhachintamani rasa, Vishnu taila Shatavari modaka, Shatamoolyadi lauha, Shatavari panaka, Brihatashwagandha ghrita (Sharma et al., 2000).

Conclusion:-

Shatavari or Satmuli is a very important medicinal plant, which is used, in many (allopathically) incurable diseases in Ayurveda and also in Himalayan traditional medicine system. Traditionally this plant is used as a reproductive tonic. It is also used as Antidepressant, Anti-diarrhoeal, Antiulcerogenic action, antibacterial, analgesic, Antioxidant etc. The plant shows the presence of many chemical constituents which are responsible for various pharmacological and medicinal properties. The evaluation needs to be carried out on *Asparagus racemosus* in order to uses and formulation of the plant in their practical clinical applications.

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