

# Pharmacological efficacies of *Asparagus racemosus*: A review

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## ABSTRACT

*Asparagus racemosus* is acquainted as Satawar, Satmuli or Shatavari plays a vital role in the tradition of ayurveda possessing various therapeutic and ergogenic properties. It also has been proven to be the potent drug for controlling AIDS symptoms. Primary screening of root extract exposed the presence of secondary metabolites, including terpenoids, alkaloids, reducing sugar, flavonoids, steroids, saponin, and glycosides. Recent Research on *A. racemosus* revealed its anti-disease properties, such as antibacterial, immune-regulation, heart disease, and anti-stress, galactogogue effect etc. Different water and alcohol based extracts of roots, leaves, flowers, and stems of the Shatavari plant are good for treating female reproductive system problems. The antimicrobial activity result showed the spectrum of inhibition against the various pathogens. The present review article deals with major pharmacological efficacies of *A. racemosus* plant.

**Keywords:** *Asparagus racemosus*, bioactive compounds, pharmacological activities, commercial uses.

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## INTRODUCTION

Nature provides us with a wide variety of plants, different parts of plants consist of numerous bioactive compounds exhibiting medicinal properties, contributing towards the production of various medicines (Chauhan et al. 2019). *Asparagus racemosus* reported as native medicinal plant of the *Liliaceae* family (Dhiman 2003). This species broadly found in tropical and subtropical regions. This plant is also called the "Queen of herb" in Ayurveda as it endorses dedication and love. The plant is 1 to 2 meters in height and is like root in gravel and sandy soil on the piedmont plain at an altitude of 1300-1400 m. The habitat is commonly shady and the climate of low altitude areas in Australia, Africa, and Asia. *A. racemosus* is widely distributed around the world, including tropical Africa, Sri Lanka, Australia, and India. The genus *Asparagus* is composed of about 300 species worldwide, 22 of which are recorded in India and are found especially in northern India. *A. racemosus* leaves are short and small, needle-like, semi-upright, uniform, and soft spines, while the stems are woody, off-white, or brown with strong spines (Bingen et al. 2003). Tuberous roots, 1-2 cm thick, clustered, and 30-100 cm long (Purohit and Vyas 2004). *Asparagus* has many valuable properties such as its root is used as rejuvenating tool, nervine tonic, galactogogue, carminative, and

stimulate milk secretion during breastfeeding. It also has anthelmintic and antiseptic properties (Sinha and Biswas 2011). In most cases, the roots part is used for medicinal purposes under the famous local name "Shatavari or Shatavar". Shatavari is depicted as a Rasayana medicine in Rigveda and Atharvaveda (Singh et al. 2018). Crude extracts, semi-purified extracts, and purified extracts from the plant have been widely used in pharmaceutical field. Shatavari enjoys the reputation of Rasayana herb in Ayurveda, which is a botanical drug that promotes overall health by increasing cell viability and resistance (Goyal 2003) and has been widely used as an adaptive drug to increase biological interactions. The plant is rich in phytoestrogen and consist highest constituents of steroids, alkaloids, proteins, flavonoids, tannins, terpenoids, and phenolic compounds, along with vitamins such as A, B1, B2, C and E and some minerals including Mg, Ca, P, Fe, and folic acid. Phytochemicals such as saponins and flavonoids and other bioactive moieties are used in a variety of therapeutic activities (Chughtai et al. 2020). The antioxidant activity of a single molecule depends on fundamental aspects, such as the number of hydroxyls, phenols, or methoxy groups, and other structural features. Besides, root extract of *A. racemosus* reported to exhibit antimicrobial activity against various common pathogens (Ravishankar et al. 2012) by the method of agar well diffusion. The root of *A. racemosus* is also recognized as cooling, moisturizing and aphrodisiac, laxative, stomachic, bittersweet, diuretic, and antiseptic. The main effects of rhizomes are reported for disease such as cough, inflammation, diarrhea, gastrointestinal tract, nervous disorders, hyperacidity, bronchitis, tumors, diarrhea, diarrhea, diarrhea, nervous disorders, liver disease, dysentery, and infectious diseases (Sharma et al. 2000; Sairam et al. 2003). The plant also possesses anti-stress and antioxidant (Kamat et al. 2000), anti-ulcer (Sairam et al. 2003), and wound healing properties (Kodancha et al. 2011). Apart from its medicinal values, *A. racemosus* is also widely used as an animal feed additive subsequently increase animal products, especially milk production and milk composition (Tsegaw and Singh 2019), effect early calving (Jamara et al.2014), broiler weight gains along with showing galactogogue effect (Alok et al. 2013). Numerous other important pharmacological activities exhibited by *A. racemosus* is shown in Figure 1.

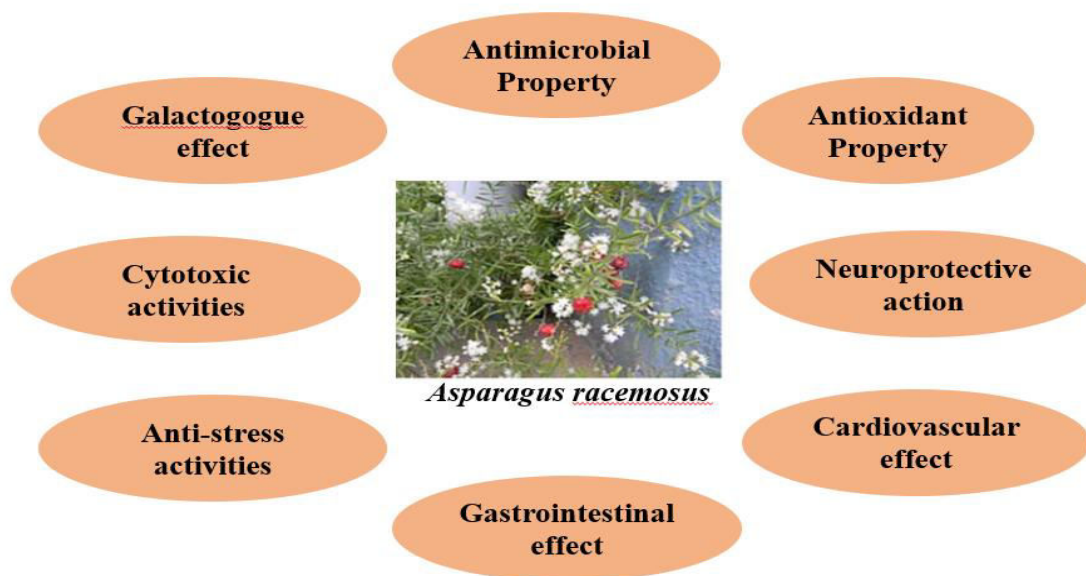


Figure1. Pharmacological activities of *A. racemosus*

### Phytochemical screening

Phytochemical screening can be used to detect biologically active molecules, which can then be used for drug discovery and pharmacological formulation (Shevale et al. 2015). The methanol and ethanol extract of *A. racemosus* root were majorly and qualitatively analyzed by researchers using standard procedures to identify the presence of various bioactive compounds. Researchers have reported on the presence or absence of numerous bioactive chemicals as a result of various testing shown in **Table 1**.

**Table 1. Phytochemical analysis of *A. racemosus* methanolic and ethanol root extracts.**

S.No.	Bioactive Compounds	Test	Methanolic Extract	Ethanol Extract	References
1	Steroids	Salkowski's test	-	+	Roy et al. 2014; Behera 2018
2	Glycosides	Keller-Killani test	+	+	Roy et al. 2014; Behera 2018
3	Phenol and Tannins	Ferric chloride test	+	+	Roy et al. 2014; Behera 2018
4	Saponin	Foam test	+	+	Roy et al. 2014; Behera 2018
5	Alkaloids	Mayer's test Wagner's test Dragendroff's test	+ + - +	- - - -	Roy et al. 2014; Behera 2018
6	Reducing Sugar	Fehling's test	-	+	Roy et al. 2014; Behera 2018
7	Terpenoids	Salkowski's test	-	+	Roy et al. 2014; Behera 2018
8	Proteins	Xanthoproteic test	+	+	Roy et al. 2014; Behera 2018

## **Pharmacological activities of *Asparagus racemosus***

### **Antioxidant properties**

Free radicals are compounds that have more than one unbounded electron in their outer orbitals (Kalia2005). This unbounded electron makes these substances very unbalanced, so due to the existence of unpaired electrons, they have considerable reactivity with other molecules, and produce more stable compounds. Methanolic roots are used as antioxidant activity. When the DPPH solution is added to the substance solution that can supply hydrogen atoms, it will cause a reduced form and lose this purple color. The destroyer is used because it inhibits apoptosis and is beneficial for gene delivery (Dohare et al. 2011). Free radicals can also degrade food and reduce its shelf life. Antioxidants can control food degradation by active free radicals, thereby act as preservatives. To minimize this situation, diet products contain large amounts of flavonoids, which are a type of polyphenol with strong antioxidant activity. The highly rich food products such as antioxidants or dietary supplements reduce the damage of cells by the free radicals. Intake of plant antioxidants is necessary for stay healthy because organic compounds are present in the plants. Certain diseases (such as aging) can be slowed down or prevented Eat foods rich in antioxidants.

### **Antimicrobial Activity**

The activity against microorganisms is reported through agar well diffusion method observing activity of different root extracts of *A. racemosus* against gram-negative and gram-positive bacteria. The result shows that compared with the standard antibiotic ciprofloxacin and acetone extract, the ethanol extract of *A. racemosus* showed moderate to high antibacterial activity against *Escherichia coli*, *Klebsiella pneumonia*, *Salmonella typhi*, and *Staphylococcus aureus*. However, compared with the ethanolic extract, the acetone extract of *A. racemosus* has the largest area of inhibition for *Bacillus subtilis*. Apart from this, methanol extract of the roots of *A. racemosus* reported to show the spectrum of inhibition against different species of *Shigella*, *Escherichia coli*, *Vibrio cholerae*, *Salmonella typhimurium*, *Bacillus subtilis*, *Pseudomonas putida*, *Staphylococcus aureus* and *Pseudomonas aeruginosa* (Ravinshankar et al. 2012). The study of this result shows that the root extract of *A. racemosus* exhibits antibacterial properties. Therefore, it is scientifically proven that they are traditionally used as medicinal plants.

### **Neuroprotective action**

In a study, root extract of *A. racemosus* was observed to enhance the normal cell count in different regions of hippocampus in mice, with no substantial change in behavioral test result. In the same study, memory retention and recall test was administered in humans treated with *A. racemosus* and significantly higher test scores were observed in the respective group comparing to the control, demonstrating neuroprotective action of *A. raemosus* (Saxena et al. 2007).

### **Cardiovascular effect**

It is reported that the root extract of the racemic root has positive ion and chronotropic effects, and high doses affect heart failure. The root extract can also produce low blood pressure in cats. It also creates congestion in the mesenteric vessels of mice and rats and completely preserves blood flow.

### **Gastrointestinal effect**

Studies have found that in healthy volunteers, the root powder of dry raceme can promote gastric

emptying. It is reported that its effect is equivalent to the synthetic dopamine antagonist metoclopramide. *A. racemosus* is used to treat ulcers of the parinama sula and stomach (Similar to the clinical entity of duodenal ulcer disease). Studies have shown that fresh juice of *A. racemosus* root has a clear therapeutic effect on patients with duodenal ulcers.

### **Anti-stress activities**

*A. racemosus*, *C. arundinaceum*, and *A. adscendens* are used as traditional medicine systems in Indians to improve health and immune diseases related to stress. Methanol extracts have a repressive effect on the production of tumor necrosis factor  $\alpha$  and cytokines interleukin  $1\beta$  of pro-inflammatory and nitric oxide in mice.

### **Cytotoxic activities**

The plant has a strong impaction effect on increased air, nourishment, gas, and vitality, boost the mind, and body. The biological effects of the ethanol extract of *A. racemosus* were studied, in this study we estimating the antidiarrheal, analgesic, and cytotoxicity characteristics of *A. racemosus*. An acetic acid-induced writhing model was used to test the analgesic activity of crude ethanol extracts in mice. The plant extract showed anti-diarrhea activity in mouse diarrhea caused by castor oil. As the number of stools increases, it increases the average incubation period and reduces the frequency of bowel movements (Hasan et al. 2016).

### **Galactagogue effect**

Galactagogue is something that help in enhancing milk supply to breast feeding mothers. In Ayurveda, extract from the root part of *A. racemosus* is used to stimulate milk supply during lactation. In a study in rats, it was observed that the dosage of 250 mg/kg (aqueous portion of the alcoholic extract) of the roots, when given intramuscularly tends to increases the weight of mammary gland tissue as well as increases the milk output of oestrogen primed rats. At the time of milking, supplementing shatavari root powder with concentrated diet enhances milk output, fat, protein, and total solids ( $p>0.05$ ) (Alok et al. 2013; Tsegaw and Singh 2019).

### **Medicinal uses**

The methanol extract of its roots has antibacterial properties against infectious diseases. It is an important digestive tonic for treating dyspepsia, indigestion and diarrhea. The root is used for chronic colic, dysentery, and diarrhea. Roots boiled with mild oil can be used for various skin diseases for humans. In milk, the root is boiled, and then the extract is used in India. It is the most important herb in herbal therapy, which can solve women's fertility problems. It can also be used to manage minor brain dysfunction and behavioral disorders (Singla and Jaitak 2014).

### **Commercial Shatavari products and their medicinal uses**

The current formulations of Himalayan herbal health products contain a lot of plant extracts (Makar et al. 2018). A huge concentration of extracts of *A. racemosus* have been used in formulation of different drugs with numerous medicinal properties distributed in market shown in (Table 2).

**Table 2. Medicinal properties of *A. racemosus* containing formulation.**

S.No.	Content of <i>A. racemosus</i>	Medicinal Property	Product Name	References
1	40mg root extract of <i>A. racemosus</i> per tablet	Leukorrhea, Malaise	Lukol	(Kumar et al. 2008)
2	32mg <i>A. racemosus</i> root extract syrup per 5ml	Menorrhagia, Dysmenorrhea, Oligomenorrhea, Metrorrhagia	EveCare	(Kumar et al. 2008)
3	80mg <i>A. racemosus</i> powder per tablet	Benign Prostatic hyperplasia	Himplasia	(Kumar et al. 2008)
4	110mg shatavar root extract per tablet	Natural and Surgical menopause	Menosan	(Kumar et al. 2008)
5	Each 5ml of syrup contains 50mg of shatavari root extract	Dysuria, Burning micturition, Hematuria	Renalka	(Kumar et al. 2008)
6	20mg root extract per tablet	Microalbuminuria, Monotherapy for non-insulin-dependent diabetes	Diabecon	(Kumar et al. 2008)
7	20mg each piece of Shatavari root powder	Geriatric Stress and anxiety	Geriforte	(Kumar et al. 2008)
8	10 mg root extract of <i>A. racemosus</i> per tablet	Hyperlipidemia Condit ions, Mild to moderate hypertension	Abana	(Kumar et al. 2008)

The root extract of *A. racemosus* is made up of multiple ingredients and has a considerable therapeutic effect as shown in **Table 3**.

**Table 3. Therapeutic effect of various extracts of *A. racemosus*.**

S. No.	Effect of Medicine	Extract Studied	Mode of Action	References
1	Extract in Alcohol	Galactagogue effect in females and animals	<ul style="list-style-type: none"> <li>Breastfeeding and prolactin properties</li> <li>Increase the weight of the breast and lobular alveolar tissues, increase estrogen milk production, and increase prolactin secretion</li> </ul>	(Garg and Gupta 2010; Singh et al. 2012)
2	Various	Uterus effect	<ul style="list-style-type: none"> <li>Decrease uterine motility</li> </ul>	(Suwannachat et

	Extracts		• Inhibit uterine contractions	al. 2012; Kinage et al. 2016).
3	Aqueous extract	Immunomodulatory activity	<ul style="list-style-type: none"> <li>• Immunomodulators: reduce adhesion</li> <li>• Immunostimulants: Produce leukocytosis and major neutrophils increase, while enhancing the phagocytic activity of macrophages and polymorphs</li> </ul>	(Muruganadan et al. 2000; Sharma et al. 2009; Thakur et al. 2012).
4	Alcoholic extract	Hepatic effect	Hepatoprotective	(Dhingra and Kumar 2007).
5	Total extract	Cardiovascular effect	<ul style="list-style-type: none"> <li>• Positive muscle strength and time-changing effect on frog heart, Cardiac arrest</li> <li>• Bleeding time increased slightly, no effect on clotting time was observed when applying the extract to rabbits</li> </ul>	(Kaushik et al. 2014).
6	Methanolic extract	Effect of Antitussive	Significant antitussive effect on sulfur dioxide induced Mouse cough	(Ravishankar et al. 2012)
7	Crude extract	Molluscicidal effect	Showed High mortality rate (100%) to <i>Aspergillus parasiticus</i>	(Kamat 2000)
8	Crude extract and purified aqueous fraction	Antioxidant effects	Crude extracts and polysaccharides (P3) partially significantly inhibit lipid peroxidation and oxidation of protein	(Wiboonpun et al. 2004)
9	Ethanollic extract	<ul style="list-style-type: none"> <li>• Anti-calculus effect (Stonehenge)</li> <li>• Crystallization inhibitor</li> </ul>	Reduced the level of $Ca^{+2}$ and $PO_4$ , oxalate, and concentration of $Mg^{+2}$ in urine.	(Thakur et al. 2009)
10	Lyophilized aqueous extract	Aphrodisiac activity	<ul style="list-style-type: none"> <li>• Significant changes in animal sexual behavior are reflected in Reduce ejaculation latency, post-ejaculation latency; insertion latency</li> <li>• The installation frequency increases, the erection of the penis is also greatly enhanced and the hesitation time is</li> </ul>	(Kanwar and Bhutani 2010)

			reduced	
11	Extracts of Methanol and aqueous	Effect of Anti-stress	Inhibition of pro-inflammatory cytokines and inhibition of nitric oxide production in mouse macrophages	(Joshi et al. 2012)
12	Aqueous and Chloroform: methanol extract	Antineoplastic Anti-cancer Liver cancer	<ul style="list-style-type: none"> <li>• Tumor suppressor</li> <li>• Improve oxidative stress and liver toxicity</li> </ul>	(Liu et al. 2009; Mitra et al. 2012; Verma et al. 2014; Khulbe 2015)

### Conclusion

*A. racemosus* has been used as an ingredient in Ayurvedic preparations for thousands of years of practice in India and its use for humans as a multi-purpose therapeutic medicinal agent and has shown great medicinal potential. The study shows that *A. racemosus* has phytochemicals, antioxidant, antibacterial activity, and pharmacological activity. Preliminary phytochemical screening of plant extracts from *A. racemosus* is necessary and carried out to understand the biological activity spectrum of plants. The phytochemical components from the extract are observed in this study. Safety analysis shows that *A. racemosus* is a safe therapeutic dose and can be used with caution during pregnancy.

**Conflicts of Interest:** The authors declare no competing interest.

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