International Journal in Physical and Applied Sciences
Volume 11 Issue 12, Dec 2024 ISSN: 2394-5710 Impact Factor: 8.202
Journal Homepage: http://ijmr.net.in, Email: irjmss@gmail.com
Double-Blind Peer Reviewed Refereed Open Access International Journal

Morphological, Phytochemical, Antibacterial and Antioxidant Evaluation of the immunity Enhancing Medicinal Plant Shatavari (*Asparagus racemosus)* in different Soil Conditions

Netra Pal Singh, Assistant Professor
Department of Botany ,Government P.G. College, Fatehabad, Agra, 283111
(Affiliated to Dr Bhimrao Ambedkar University, Agra) 282004 (India)

Abstract: The study examined Shatavari *(Asparagus racemosus)*, focusing on how soil and climatic conditions affect their Morphology and immune-boosting properties. Morphological studies showed that vermicompost improved plant height, flowering, fruiting, seed development, and root size/shape. Phytochemical analysis of methanol root extracts revealed the presence of alkaloids, glycosides, flavonoids, phenols, saponins, steroids, and tannins. Antibacterial tests demonstrated effectiveness against *E. coli*, *Pseudomonas aeruginosa*, *Staphylococcus aureus*, and *Bacillus subtilis*. These results support the traditional medicinal use of these plants and highlight their potential as plant-based antimicrobial agents. ***Asparagus racemosus,*** exhibiting notable DPPH radical scavenging, which increased with higher extract concentrations, indicating its strong antioxidant capacity.

Keywords: Shatavari (*Asparagus racemosus)* ,Morphological, Phytochemical, and Antibacterial and antioxidant.

1. INTRODUCTION

Asparagus racemosus, commonly known as Shatavari, is a spiny under-shrub native to tropical and subtropical regions of India. It thrives at elevations of up to 1500 meters and is characterized by tuberous roots, which are used in traditional medicine. Shatavari holds significant importance in Ayurveda, often referred to as the "Queen of Herbs" due to its rejuvenating effects. The plant contains steroidal saponins and sapogenins, which contribute to its therapeutic properties. Shatavari is recognized for a variety of health benefits, including antispasmodic, anti-inflammatory, anti-diabetic antioxidant, immune-boosting, and hepatoprotective properties, among others. It is commonly used to promote vitality and support overall health. The present study explores the morphological, phytochemical, and antibacterial, antioxidant characteristics of Asparagus racemosus, with a focus on how different soil types and climatic conditions in Agra influence its immune-enhancing properties.

A. racemosus is widely distributed across the globe and its distribution ranges from tropical Africa, Java, Australia, Sri Lanka, Southern parts of China and India, but it is mainly cultivated in India (1) .

Vernacular names(2)

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

Crops mainly need tropical, hot climatic conditions and require minimum irrigation with the avoidance of overwatering. Raised beds which are about 3 m 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 . (3)

Many medicinal plants, particularly those used in Ayurveda and Unani systems, are recognized for their antimicrobial properties and therapeutic applications. Their leaves serve multiple purposes, including antibacterial, anti-helminthic, astringent, emetic, febrifuge,

sedative, and stimulant effects. Natural products, whether as isolated compounds or standardized plant extracts, present considerable promise for the development of novel pharmaceuticals. Antibiotics, in particular, remain the primary treatment for bacterial infections (4).
Root- It is the most important part of plant, root are fasciculated , tuberous, and fleshy. They are spindle- shaped, about 10-30 cm long and 0.1-0.5 cm thick.
Stem- Green, climbing and spiny. Height1-4 meters.
Flowers- small, white, and arranged in solitary, pedicellate, actinomorphic and bisexual.
Fruit and seeds- The fruit is small, 0.5- 0.6 cm , fleshy, berry that turns from green to red.

2. MATERIAL AND METHODS

The current study was carried out at the Botanical Garden of R.B.S. College in Agra to examine the impact of different soil conditions

2.1 ***Ordinary Soil:*** Garden soil was collected from a 25 cm thick layer of a cultivated field, then finely sieved before use.
2.2 ***Farm Yard Manure (F.Y.M.)*****:** F.Y.M. was combined with the cultivated field soil in a 1:1 ratio, and this mixture was used to fill the pots.
2.3 ***Vermicompost*****:** Freshly produced vermicompost was sourced from a local supplier and was mixed in small quantities with garden soil.

For the experiment, Asparagus racemosus tubers were planted in earthen containers. The pots, freshly taken from the water tank and allowed to dry, were filled with the potting mixture. Each container was precisely filled with 4-4.50 kg of the mixture, leaving about 3-4.00 cm of space at the top to accommodate water application.

3. ***Morphological Studies:*** Ten plants were selected and tagged for a year-long morphological study, during which data on plant, leaf, flower, fruit, and seed morphology was collected.

4. ***Plant Collection and Extract Preparation:*** Tubers of *Asparagus racemosus* were collected from the Earthern Pots Botanical Garden at R.B.S. College, Agra, U.P. After washing the tubers under running tap water and drying them on paper towels, the aerial parts were blended. The mixture was then extracted with methanol by macerating at room temperature (30°C) for 72 hours. The macerated product was filtered under vacuum, and the resulting filtrate was evaporated under reduced pressure to calculate the percentage yield of the root extract.

5. ***Phytochemical studies:*** The powdered root was analyzed to determine the qualitative presence of the following key phytochemicals.

5.1 Test for Alkaloid

A- Mayer's Test: To test for the presence of alkaloids, 2 ml of plant extract was mixed with 5 ml of 1% aqueous HCl. Then, 100 µl of freshly prepared Mayer's reagent was added. The formation of a buff-colored precipitate confirms the presence of alkaloids (5).

B-Test for Glycosides: Legal Test: A small quantity of pyridine was introduced to the sample in a test tube, followed by a few drops of alkaline sodium nitroprusside solution. The appearance of a blood-red color indicates the presence of glycosides.

C-Test for Steroids: Salkowski Test: The test involves mixing 0.5-1 ml of the test solution with chloroform in a test tube. After adding a few drops of concentrated sulfuric acid and shaking, the appearance of a red color in the lower layer indicates the presence of steroids.

D-Test for Flavonoids: 2 ml of 10% sodium hydroxide was added to 2 ml of the filtrate, resulting in a yellow color that turned colorless upon the addition of dilute hydrochloric acid, indicating the presence of flavonoids (6).

E-Test for Phenols: A few drops of a 10% ferric chloride solution were added to 2 mL of the extract. The development of a bluish-green or black coloration confirms the presence of phenolic compounds (5).

F-Test for Saponins: The experiment involved mixing 2 ml of plant extract with 2 ml of distilled water in a test tube and shaking it vigorously. The formation of a frothy foam suggests the presence of saponins in the plant extract (5).

G-Tannins: *FeCl3 Test:* When 2 mL of plant extract is mixed with a few drops of 0.1% FeCl3 (ferric chloride) solution, the appearance of a blue-green or blackish-green color or precipitate suggests the presence of tannins in the plant extract. This is a positive test for tannins, as they react with FeCl3 to form these characteristic colors. (6).

6.Antibacterial Activity Study: The antibacterial properties of methanolic root extracts of Shatavari (*Asparagus racemosus)* , grown under different soil conditions, were evaluated using the agar well-diffusion method[(7)]. Mueller–Hinton Agar served as the growth medium, and extracts were prepared in DMSO at a concentration of 10 mg/ml. A standardized bacterial inoculum was evenly spread on the agar plates, after which 6 mm wells were made and filled with 40 µl of the extracts at varying concentrations. Plates were incubated at 37 °C for 24 hours. Antibacterial effectiveness was determined by measuring the inhibition zone diameters surrounding each well. Ciprofloxacin (40 µl) served as the positive control. All tests were conducted in triplicate to ensure accuracy.

The extracts were tested against four human pathogenic bacteria:

- *Escherichia coli*
- *Bacillus subtilis*
- *Pseudomonas aeruginosa*
- *Staphylococcus aureus*

7. DPPH Inhibition Assay:

DPPH was added (0.01gm in 100 ml methanol) in all series one by one and was mixed properly, and incubated in dark for 30 min. Blank used was 1.5 ml methanol and Control used was methanol + DPPH (1:1) and absorbance was taken at 517 nm. The DPPH scavenging activity was calculated in percentage by following formula:

$$\% \text{ inhibition of DPPH} = \{(A_B - A_S)/A_B\} \times 100$$

Where, A_B was the absorbance of the blank and A_S was the absorbance of sample.

8. RESULTS AND DISCUSSION

8.1 Morphological Observations of Asparagus racemosus in Various Soil Conditions

A-Plant Morphology: Asparagus racemosus is a small to medium-sized, erect annual herb. The plant has a branched stem, The stems is straight, smooth, and shiny yellow with the branches being that reaches a height up to 90-100 cm. in ordinary soil 110-115cm in farm yard manure. whereas those grown in vermicompost can attain up to 120cm.

B-Leaf Morphology: The leaves are simple, small reduced to minute needle like scals. The leaf size is fairly consistent across different soil conditions.

C-Flower Morphology: Asparagus racemosus produces small, white flowers on short, spiky stems.Largest flower size, measuring 0.40 cm, was observed in plants grown in vermicompost. Similarly, plants grown in farmyard manure also exhibited flowers of 0.40 cm, while those cultivated in ordinary soil showed no significant difference in flower size.

D-Fruit Morphology: Fruiting primarily occurs between September and October. The fruits are small, round, and measure 0.5–0.7 cm in diameter. They range in colour from light orange to dark orange, with a glossy outer skin. In the early stages, the fruits are globular or faintly three-lobed, green in colour, and become red upon maturing. They are typically 8–10 mm in diameter, sometimes reaching up to 13 mm, and generally contain one seed, though occasionally there may be two to three seeds.

E-Seed Morphology: The seeds are small and black in colour, with each fruit containing one or two seeds. The seeds have a dry texture and, in September, as they ripen, they turn purplish-black.

F- Root Morphology: The study on root morphology in *Asparagus racemosus* plants examined root length, width, and colour under different soil conditions. The longest roots (13.50 cm) were found in plants grown in vermicompost, followed by those in farmyard manure (12.00 cm) and ordinary soil (11.00 cm).
results reveal that these methanol extracts are particularly rich in a variety of phytochemical compounds. Notably, the extracts consistently contain high levels of alkaloids, glycosides, flavonoids, phenols, saponins, steroids, and tannins across all soil types. various researchers have consistently reported similar findings regarding Asparagus racemosus. These finding show slightly similarities from previous work (8).
The root extract of *Asparagus racemosus* was evaluated for its phytochemical components to identify the presence of alkaloids, flavonoids, tannins, phytosterols, and glycosides.

9.Antibacterial Studies: The antibacterial properties of methanol extracts (40 µl) from the roots of Asparagus racemosus, cultivated under different soil conditions, were evaluated against four human pathogenic bacteria: *Escherichia coli*, *Bacillus subtilis*, *Pseudomonas aeruginosa*, and *Staphylococcus aureus*. The findings are presented in Table 1. Table 1clearly indicates that the strongest antibacterial activity was observed against *Pseudomonas aeruginosa*, with the largest zone of inhibition measuring 18.50 mm when plant roots were cultivated in vermicompost. In contrast, the weakest activity was observed against *Escherichia coli*, with a maximum inhibition zone of 11.00 mm in roots grown in ordinary soil. The disc diffusion method revealed that the root extract possesses notable antibacterial

properties. For comparison, Ciprofloxacin (40 µl) was utilized as a control antibiotic. This study evaluated the antimicrobial properties of *Asparagus racemosus* root extracts, finding that methanolic extracts exhibit significant antibacterial activity against E. coli, *Pseudomonas aeruginosa*, *Staphylococcus aureus*, and *Bacillus subtilis*. These results support the traditional use of the plant in treating microbial infections and highlight its potential as a source of antimicrobial agents.
Methanolic and ethalonic root extract shows antibacterial activity against Escherichia coli, Shigella dysenteriae, Vibrio cholerae, Basillus subtilus, Staphylococcus aureus, Shigella sonnei, Shigella flexneri. Owing to its antibacterial property Shatavari can be utilized in place of synthetic antibacterial drugs (13) .

Table 1. Antibacterial activity of methanol Root extract of *Asparagus racemosus* against some human pathogenic Bacteria in various soil conditions

Sample		Inhibition zone (mm)				
	Name of Bacteria	*E.coli*	*P. aeruginosa*	*B. subtilis*	*S. aureus*	Standard
	Concentration	40 µl	40 µl	40 µl	40 µl	(40 µl)
1	Ordinary Soil	11.00	14.00	14.00	14.50	37
2	Farm yard	12.50	14.50	15.00	15.50	37
3	Vermicompost	15.00	18.50	17.50	17.00	37

10.. Phytochemical Analysis: The methanol extracts from *Asparagus racemosus*, grown in different soil conditions, show a consistently rich phytochemical profile. Across all soil types, the extracts contain high levels of alkaloids, glycosides, flavonoids, phenols, saponins, steroids, and tannins, indicating that soil variation does not significantly diminish the plant's ability to produce these key bioactive compounds
. Secondary metabolites, on the other hand, serve as defense mechanisms and include terpenoids, alkaloids, phenolic compounds, saponins, and flavonoids, among others [9-10).
The root extract of A. racemosus was screened for phytochemical constituents to determine the presence of alkaloids, flavanoids, tannins, phytosterols, glycosides. The ethanolic root extract of A. racemosus revealed the presence of alkaloids (11,12), flavanoids, tannins, phytosterols, glycosides, carbohydrates, proteins and fats.

Table 2. Phytochemical studies of root extract of Asparagus racemosus in various soil conditions

S. No.	Phytochemicals	Ordinary Soil	Farm yard Manure	Vermicompost
1.	Alkaloids	+	+	+
2,	Glycoside	+	+	+
3	Flavonoid	+	+	+
4.	Phenols	+-	+	+
5.	Saponin	+	+	+
6	Steroids	+	+	+
7.	Tanins	+	+	+

Table 3. Antioxidant Activity (DPPH Assay) in Methanol Extract of root of *Aspergus racemosus* in vermicompost

S.No.	Sample	Wavelength(nm)	% inhibition (C-S/C×100)
	Control	**.298**	
1.	10 µl	.225	24.49
2.	20 µl	.205	31.20
3.	30 µl	.188	36.91
4.	40 µl	.164	44.96
5.	50 µl	.147	50.67
6.	60 µl	.140	53.02
7.	70 µl	.132	55.70
8.	80 µl	.125	58.05
9.	90 µl	.111	62.75
10.	100 µl	.105	64.76

To determine the antioxidant activity of a specific solution, a significant decrease in absorbance is expected for samples containing antioxidant compounds. The crude methanol extract of *Asparagus racemosus* was subjected to the DPPH radical scavenging assay at various concentrations. The results are presented in Table 3 .

CONCLUSION

The study assessed the growth of under different soil conditions, noting that farmyard manure and vermicompost significantly enhanced the morphological parameters. Phytochemical analysis of methanol root extracts revealed alkaloids, glycosides, flavonoids, phenols, saponins, steroids, and tannins.

Phytochemical analysis of methanol extracts from the roots identified several bioactive compounds, including alkaloids, glycosides, flavonoids, phenols, saponins, steroids, and tannins. Additionally, the root extracts demonstrated antibacterial activity against *E. coli*, *Pseudomonas aeruginosa*, *Staphylococcus aureus*, and *Bacillus subtilis*. The results indicate that methanol is an efficient solvent for extracting these bioactive compounds, which could potentially contribute to the advancement of traditional medicine and offer a promising alternative in addressing bacterial infections and combating drug resistance.

antioxidants in the plant extracts to scavenge free radicals. The methanol extracts of showed significant antioxidant activity, exhibiting notable DPPH radical scavenging, which increased with higher extract concentrations, indicating its strong antioxidant capacity.

REFERENCES

1. Kirtikar, Basu. Indian medicinal plants. Dehradun, India: Bishen Singh Mahendra Pal Singh 1985.
2. Bopana N and Saxena S: Asparagus racemosus— Ethnopharmacological evaluation and conservation needs. J Ethnopharmacol 2007; 110:1-15.
3. Kundu M, Mazumder R, Kushwaha M, Chakraborthy G and Kundu M: Standardization profiles of roots of Asparagus racemosus wild. Pharmacologyonline 2011; 3:587-592.
4. Tambekar, D.H. and Khante, B.S. 2010. Antibacterial evaluation of medicinal plants used by *korkus* In melghat forest against gastrointestinal infections. Ijpsr; 3(9): 120-128.
5. Sofowora, A. 1993. Medicinal Plants and Traditional Medicinal in Africa. 2nd Ed. Sunshine House, Ibadan, Nigeria: Spectrum Books Ltd;. *Screening Plants for Bioactive Agents*; pp. 134–156.

6. Trease, G.E.,Evans, W.C. 1998. A Textbook of Pharmacognosy, thirteenth ed. Bailliere Tindall, London, pp. 45-50.
7. C.Perez Paul M., Bazerque P. Antibiotic assay by agar well diffusion method. Acta Biol. Med. Exp. 1990; 15 113–115.
8. Wani J.A, Achur R.N, Nema R.K. 2011. Phytochemical screening and aphrodisiac activity of Asparagus racemosus. *International Journal of Pharmaceutical Sciences and Drug Research*, 3(2):112-115.
9. S. Veer Sawate, A. Kshirsagar, R. Agarkar, B. Patil, B. Studies on quality assessment of ashwagandha root (Withaniasomnifera) powder. Int. J. Chem. Stud. 2019;7(2):556-559.
10. S,Bargale Tripathy T.B, Shashirekha H. Phyto physicochemical profile of Ashwagandha (WithaniasomniferaDunal). J. Ayurveda Integr. Med. Sci. 2020; 5(6):120-129.
11. Roy RN, Bhagwager S, Chavan SR, Dutta NK. Preliminary pharmacological studies on extracts of root of Asparagus racemosus (Satavari), Willd, Lilliaceae. J Res Indian Med. 1971;6:132-138. 5.
12. Dalvi SS, Nadkarni PM, Gupta KC. Effect of Asparagus racemosus (Shatavari) on gastric emptying time in normal healthy volunteers. J Postgrad Med. 1990;36:91-94. 6.
13. Joshi J, Dev S. Chemistry of Ayurvedic crude drugs: Part VIIIa-Shatavari-2: Structure elucidation of bioactive Shatavarin-I & other glycosidesb. Indian J Chem. 1988;27:12-16.