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Study of Morphology and Medicinal Properties of Shatavari (*Asparagus racemosus*) in different Soil

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ABSTRACT

Shatavari is a Prominent medicinal herb in Ayurvedic medicine system. This plant's therapeutic uses have been documented in India, British Pharmacopoeia and traditional medical systems like Ayurveda, Unani, Siddha.In this research paper, we will primarily investigate the various medicinal properties found in the shatavariplant . Asparagus plants were cultivated in various types of soil(Oridinary soil, FYM and Vermicompost). Morphological studies showed improvements in plant height, flower, fruit, and seed parameters when grown in vermicompost. The shape and size of the roots were significantly enhanced in the vermicompost mixture. Phytochemical analysis of methanol extracts from the roots of *Asparagus racemosus*, cultivated under different soil conditions, confirmed 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 plantbased antimicrobial agents. *Asparagus racemosus*, exhibiting notable ABTS radical scavenging, which increased with higher extract concentrations, indicating its strong antioxidant capacity.

Keywords: Shatavari (*Asparagus racemosus*) ,Morphological, Phytochemical, antibacterialand antioxidant

INTRODUCTION

Asparagus racemosus belongs to the Asparagaceae family, is commonly called Shatavari. Shatavari is a climbing plant with a tuberous, short rootstock that produces a plethora of succulent tuberous roots. Ayurveda considers Shatavari to be a powerful Rasayana that promotes longevity, improves immunity. In Ayurveda, Shatavari is classified as a "Rasayana" (rejuvenative) herb, believed to nourish and restore balance to the body and mind. *Asparagus racemosus* (Shatavari) stands out as one of the most commonly used herbs in traditional medicine, renowned for its rich content of steroidal saponins and sapogenins. In Ayurveda, Shatavari is honored as the "Queen of Herbs" and is traditionally employed as a health tonic, celebrated for its rejuvenating properties and ability to enhance vitality. It is native to India and is widely used in Ayurvedic medicine for its medicinal properties. There are over 300 species of Asparagus in the world, with 22 species reported in India. *Asparagus racemosus* is found all over the world, including populations in tropical Africa, Java, Australia, Sri Lanka, southern China, and India, however it is primarily grown in India.

Its medicinal properties lie mainly in the root, which contains several bioactive compounds, including saponins, alkaloids, flavonoids, glycosides, and polysaccharides. The primary active constituents that contribute to its medicinal benefits are asparaguses, which are believed to have antioxidant, anti-inflammatory, and immune boosting properties (1, 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

1.Ordinary Soil: Garden soil was collected from a 25 cm thick layer of a cultivated field, then finely sieved before use.

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.

3.*Vermicompost*: Freshly produced vermicompost was sourced from a local supplier and was mixed in small quantities with garden soil.

Asparagus plants were grown in three types of soil and their morphological observation were done.

1. ***Morphological Observation:***Twelve plants were selected and tagged for a year-long morphological study, during which data on plant, leaf, flower, fruit, and seed morphology was collected.
2. ***Phytochemical studies:*** The powdered root was analyzed to determine the qualitative presence of the following key phytochemicals.

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.

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.

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.

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.

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.

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 .

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 colour 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 colours. .

Anti-Bacterial studies: The antibacterial properties of the samples were evaluated using the agar well-diffusion technique, as outlined by Mueller-Hinton Agar (MHA, Hi Media, India, no. 2) was employed as the bacterial growth medium. Extracts were prepared in dimethyl sulfoxide (DMSO) at a concentration of 10 mg/ml. A standardized bacterial inoculum, diluted in sterile 0.9% saline, was used to inoculate the agar plates. Wells, 6 mm in diameter, were created on the MHA plates, and 40 µl of each extract at varying concentrations was introduced into the wells. The plates were then incubated at 37°C for 24 hours. Antibacterial activity was determined by measuring the diameter of the inhibition zones surrounding each well. Ciprofloxacin (40 µl) served as a control antibiotic. The experiment was performed in triplicate to minimize experimental errors, and the mean values were calculated. The four human pathogenic bacteria used in the assay were *Escherichia coli*, *Bacillus subtilis*, *Pseudomonas aeruginosa*, and *Staphylococcus aureus*. The antibacterial activities of methanol extracts (40 µl) derived from the roots of *Asparagus racemosus*, cultivated under various soil conditions, were tested.

IV. Evaluation of the immunebooster (antioxidant activity) studies

The freeradicals scavengingpotential ofthe immunebooster formulationwas evaluatedusing the following assays: DPPH and ABTS assay's radical scavenging.

Collection of Plant Materials The roots were washed under running tap water and shade dried for three weeks. The dried roots were then homogenized by using a grinder to make fine powder and stored in air tight bottles.

Methanol extract:

The collected roots were washed twice in running tap water and once with sterile distilled water subsequently. The roots were shade dried for three weeks and made to coarse powder. The powder of roots was passed through whatman filter No. 40 to achieve uniform particle size and then used for extraction process. A weighed quantity of the powder was subjected to continuous hot extraction in soxhlet apparatus with 85 % methanol solvent. The extract was dried using rotator vaccum evaporator and they give molten extract and store at 4^{o} C until further use.

(ii)$ABTS^{\bullet+}$ assay
Procedure (Zheleva-Dimitrova *et al*., 2010 and Roberta *et al.*, 1999 with some modifications)

ABTS was dissolved in water to make a concentration of 7 mmol/l. $ABTS^{+}$ was produced by reacting the ABTS stock solution with 2.45 mmol/l potassium per sulfate (final concentration) and the mixture was left in the dark at room temperature for 12–16 hrs. before use. The $ABTS^{+}$ stock solution was diluted with 80 % methanol to an absorbance of 0.70 ± 0.02 at 734 nm. 1 ml of diluted $ABTS^{+}$ was added into 10-100 µg/ml samples. The absorbance reading was taken at 6 min after the initial mixing. The activities of the samples were evaluated by comparison with a control (containing 1 ml of ABTS solution and 1ml methanol). $ABTS^{+}$ scavenging activity was calculated by the following formula:

$ABTS^{+}$ scavenging activity (%) = $[(A_c - A_s)/A_c] \times 100$

Where A_C is the absorbance value of the control and A_S is the absorbance value of the added samples test solution.

Morphological and Botnical Description-

Height: Typically grows up to 1.5–2 meters (about 5–6 feet) tall.

Stem: The stems are thin, wiry, and often branched, supporting the plant's climbing habit.

Leaves: leaves are small, needle-like, and scale-like, arranged in clusters along the stems. They are generally green and can be somewhat feathery in appearance.

Flowers: Shatavari produces small, white to pale green flowers that are usually fragrant. These flowers are clustered in racemes.

Fruit: The plant bears small, round berries that turn red or orange when ripe. Roots: The part of the plant used medicinally is the tuberous root, which is thick, fleshy, and has a starchy texture. The roots are often harvested for their therapeutic properties. The plant is native to the Indian subcontinent and is commonly found in forests and other natural habitats in the region.

Fig- 1 Seeds of *Asparagus racemosus*

Fig- 2 Pants Growing in Various soils

A - Ordinary SoilB - FYM C - Vermicompost

Fig- A. Inflorescence

Fig- B. Fruit

RESULTS AND DISCUSSION

Plant Morphology:

Height upto100-110 cm. in ordinary soil, 110-115 cm in farm yard manure. whereas those grown in vermicompost can attain up to 120 cm.

Leaves: leaves are small, needle-like, and scale-like, arranged in clusters along the stems. They are generally green and can be somewhat feathery in appearance. The leaf size is fairly consistent across different soil conditions.

Flower Morphology

Asparagus racemosus produces small, white flowers on short, spiky stems. These flowers are clustered in racemes.

Table -1 indicates that the 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.

The length and width of the tepals remained consistent across all soil conditions. The flowers possess a perianth consisting of six obovate tepals, ranging from 2.5 to 3.00 mm in length and 1 mm in width. The androecium consists of six stamens with white filaments and dark brown anthers. The style is

short, approximately 0.5 mm long, with three recurved stigmas. Both the stigma and the ovary are well-developed.

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 color 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 color, and become red upon maturing. They are typically 8–10 mm in diameter, sometimes reaching up to 13 mm, andgenerally contain one seed, though occasionally there may be two to three seeds.

Seed Morphology: The seeds are small and black in color, with each fruit containing one or two seeds. The seeds have a dry texture and, in September, as they ripen, they turn purplish-black. When fully mature, the seeds become hard and brittle.

Root Morphology: The study on root morphology in *Asparagus racemosus* plants examined root length, width, and color under different soil conditions. The longest roots (15.00 cm) were found in plants grown in vermicompost, followed by those in farmyard manure (13.00 cm) and ordinary soil (12.00 cm). The roots are fleshy, fibrous, cylindrical, and white, with a tuberous, radish-like shape, tapering at the ends. They typically grow in clusters, with 10-12 roots per plant across all soil conditions.

The morphological characteristics of the Asparagus racemosus plant, including its unique stem structure, flowers, and fruit, provide important clues for botanists and medicinal researchers in identifying and understanding its medicinal properties. The consistent findings from various studies over time, including those from Hooker (6);. and others,(7) confirm the plant's morphological features and its relevance in different regions. The clustering of roots and the presence of needle-like cladodes offer valuable insights into its growth patterns and ecological adaptations. The fruit is a small berry (8). In addition, *Asparagus* plants have tuberous roots that grow in clusters at the base of the stem (9) noted that these tuberous roots are clustered at the stem's base. Other studies on the morphology of *Asparagus* species, including those by (9,10) have confirmed these findings, providing additional support for the observations in our study. The fruit is a small berry (8). In addition, *Asparagus* plants have tuberous roots that grow in clusters at the base of the stem (9) noted that these tuberous roots are clustered at the stem's base. Other studies on the morphology of *Asparagus* species, including those by (10) and (9), have confirmed these findings, providing additional support for the observations in our study.

Table 1. Morphological characters of Asparagusracemosusin various soil conditions

SN	Name of Soil	Morphological Characters				
		Height	Length of Flower	Fruits (Diametre)	No of seed Per Fruits	Root
1.	Ordinary soil	100 – 110cm	0.4 cm	0.6-0.7 cm	2-3	12cm
2.	FYM	110 - 115cm	0.4 cm	0.6-0.7 cm	2-3	13cm
3.	Vermicompost	115-120	0.4 cm	0.6-0.7 cm	2-3	15cm

Phytochemical Analysis:Table-2 presents the findings from the phytochemical analysis of methanol extracts from the tubers of Asparagus racemosus, cultivated under different soil conditions. Theresults 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 of (11). The root extract of *Asparagus racemosus* was evaluated for its phytochemical components to identify the presence of alkaloids, flavonoids, tannins, phytosterols, and glycosides. The ethanolic root extract of *A. racemosus* was found to contain alkaloids (12), flavonoids, tannins, phytosterols, glycosides, carbohydrates, proteins, and fats. Additionally, trace elements such as copper, zinc, manganese, cobalt, potassium, calcium, and selenium were detected (13). The fruits and flowers of Shatavari also contain flavonoids, specifically glycosides of quercetin, rutin, and hyperosides (14).

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

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

Table 3. 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	15.00	37
2	Farm yard	11.50	14.50	15.00	15.50	37
3	Vermicompost	15.00	18.50	17.50	16.50	37

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 3. Table 3 clearly 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.

Antioxidant activity in*Asparagus recemosus* in vermicompost soil

To measure the antioxidant activity of a solution, a significant decrease in absorbance is expected in samples containing antioxidant compounds. The crude methanol extracts of *Asparagus racemosus* were tested using the ABTS radical scavenging assay at different concentrations. The crude methanol extract of *Asparagus racemosus* demonstrated ABTS radical scavenging activity, with inhibition percentages of 34.00%, 34.95%, 36.15%, 36.82%, 37.63%, 38.44%, 39.51%, 41.80%, 42.47%, and 44.08% for concentrations of 10 µl, 20 µl, 30 µl, 40 µl, 50 µl, 60 µl, 70 µl, 80 µl, 90 µl, and 100 µl, respectively.

Table 4. Antioxidant Activity (ABTS Assay) in Methanol Extract of root of *Asparagus racemosus* in vermicopost

S.NO.	Sample	Wavelength(nm)	% inhibition (C-S/C×100)
	Control	**.744**	
1.	10 µl	0.491	34.00
2.	20 µl	0.484	34.95
3.	30 µl	0.475	36.15
4.	40 µl	0.470	36.82
5.	50 µl	0.464	37.63
6.	60 µl	0.458	38.44
7.	70 µl	0.447	39.91
8.	80 µl	0.433	41.80
9.	90 µl	0.428	42.47
10.	100 µl	0.416	44.08

Conclusion

Asparagus racemosus under varying soil conditions, focusing on morphological studies with its root development when treated with farmyard manure and vermicompost. 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. The antioxidant activity of ***Asparagusracemosus***varied with extract concentration, highlighting the importance of dosage for therapeutic use. Additionally, methenolic extract was found to exhibit the highest antioxidant activity at both low and high concentrations, with the reducing power assay showing the best results overall.

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