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Comparative Evaluation of Antibacterial Activity of Selected Wild Edible Plants from Gadchiroli District, Maharashtra (India)

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Abstract: ***Wild edible plants are known to harbor an abundance of bioactive compounds that contribute to their nutritional and therapeutic potential. The present study investigates the antibacterial activity of methanolic extracts from four wild vegetables traditionally consumed by the tribal communities of Gadchiroli district, Maharashtra - Alternanthera paronychioides St. Hil. Voy., Phoenix acaulis Roxb., Holarrhena pubescens (Buch-Ham.) Wall. ex G. Don, and Olax psittacorum (Willd.) Vahl. The antibacterial potential was evaluated using the agar well diffusion method against two clinically significant bacterial strains, Escherichia coli (Gram-negative) and Staphylococcus aureus (Gram-positive). Results revealed considerable variation in the species, with Holarrhena pubescens demonstrating the strongest inhibitory effects, while Phoenix acaulis exhibited weak activity. The findings validate the ethnomedicinal relevance of these wild plants and suggest that they could serve as natural sources for novel antibacterial agents.***

Keywords: Wild edible plants; antibacterial screening; agar well diffusion; *Escherichia coli*; *Staphylococcus aureus*; phytochemicals; methanolic extracts

1. Introduction

Antimicrobial resistance has emerged as one of the greatest global public health threats of the 21st century. The overuse and misuse of synthetic antibiotics have accelerated the evolution of resistant bacterial strains, diminishing the efficacy of conventional drugs. Consequently, there is an urgent need to explore novel antibacterial compounds from natural sources, particularly plants that have evolved complex biochemical defense systems against microbial invasion [1–3].

Wild edible plants, often overlooked in modern pharmacognosy, are reservoirs of bioactive metabolites such as alkaloids, phenolics, flavonoids, and terpenoids [4]. These compounds confer protective properties not only against herbivory but also against microbial pathogens. In rural and tribal communities, such plants have historically been used as dietary supplements and home remedies for common infections [5,6]. The ethnobotanical relevance of these species underscores their potential as valuable sources of antimicrobial agents [7].

The tribal population of Gadchiroli district in Maharashtra, India, depends significantly on forest vegetation for food and medicine. Several wild vegetables consumed locally are known for their medicinal properties, yet systematic scientific validation of their antimicrobial activity remains limited. This study aims to fill that gap by conducting a comparative antibacterial screening of four such plants — *Alternanthera paronychioides*, *Phoenix acaulis*, *Holarrhena pubescens*, and *Olax psittacorum*. The focus is to determine their inhibitory potential against *Escherichia coli* and *Staphylococcus aureus*, thereby assessing their possible role in the development of plant-based antibacterial formulations.

2. Materials and Methods

2.1 Plan Material Collection

Fresh specimens of the selected wild vegetable plants were collected from the forests surrounding Kamlapur and nearby tribal areas of Gadchiroli District, Maharashtra, during the monsoon and post-monsoon seasons. Identification and authentication were carried out by a recognized botanist from the Department of Botany, RTM Nagpur University, Nagpur, India. The plant parts used included leaves (*A. paronychioides*), underground petioles (*P. acaulis*), flowers (*H. pubescens*), and leaves/shoots (*O. psittacorum*).

2.2 Preparation of Plant Extracts

The collected plant materials were washed thoroughly with distilled water, air-dried in shade, and pulverized into fine powder. About 20 g of each powdered sample was soaked in 200 mL of methanol for 48 hours at room temperature with occasional shaking. The filtrates were concentrated under reduced pressure using a rotary evaporator and stored at 4°C until further use.

2.3 Microorganisms and Culture Media

Two bacterial strains — *Staphylococcus aureus* (Gram-positive) and *Escherichia coli* (Gram-negative) — were procured from the Microbiology Laboratory, Department of Microbiology and Biotechnology, Sardar Patel Mahavidyalya Chandrapur. Cultures were maintained on nutrient agar slants at 4°C and sub-cultured before each assay.

2.4 Antibacterial Assay

The antibacterial activity of each extract was determined by the agar well diffusion method [8]. Sterile Mueller–Hinton agar plates were inoculated with bacterial suspensions adjusted to 0.5 McFarland standard (approximately 1×10^8

CFU/mL). Wells (6 mm diameter) were bored aseptically and filled with 100 µL of extract solutions (25, 50, and 100 mg/mL). Methanol served as the negative control, while standard antibiotics (Gentamycin, 10 µg/mL) acted as the positive control. Plates were incubated at 37°C for 24 hours, and the zones of inhibition were measured in millimeters.

3. Results and Discussion

3.1 Antibacterial Activity of positive Control (Gentamycin) and solvent.

The antibacterial activity of the positive control (Gentamycin) and the solvents (SDW, Ethanol, and DMSO) was evaluated against *Escherichia coli* and *Staphylococcus aureus* by measuring the zone of inhibition. For *E. coli*, the standard antibiotic (Gentamycin) exhibited a clear inhibitory zone of 20 mm, confirming its strong antibacterial effect. In contrast, sterile distilled water (SDW) showed a slight inhibition zone of 10 mm, while both Ethanol and DMSO produced no inhibition (NI), indicating no antibacterial activity. Similarly, in the case of *S. aureus*, Gentamycin demonstrated a prominent inhibition zone of 22 mm, validating its effectiveness against Gram-positive bacteria. However, none of the solvents (SDW, Ethanol, or DMSO) showed any inhibitory effect, as indicated by the absence of inhibition zones. These results confirm that Gentamycin served as an effective positive control, while the solvents did not interfere with antibacterial activity [9,10].

Table 1: Zone of inhibition in mm of positive Control (Gentamycin) and solvent

Zone of inhibition in mm for (*E. coli*)				
	SDW	Ethanol	DMSO	Antibiotic
***E. coli* - Control**	10	NI	NI	20

Zone of inhibition in mm (*S. aureus*)				
	SDW	Ethanol	DMSO	Antibiotic
S. aureus - **Control**	NI	NI	NI	22

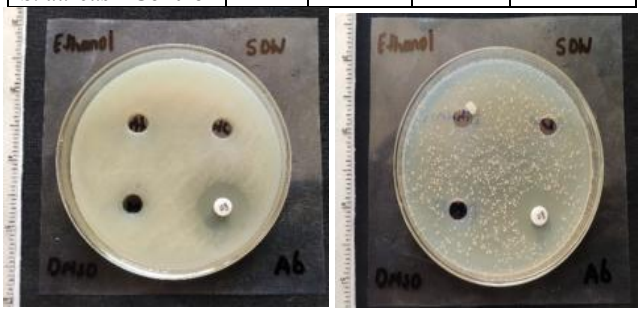


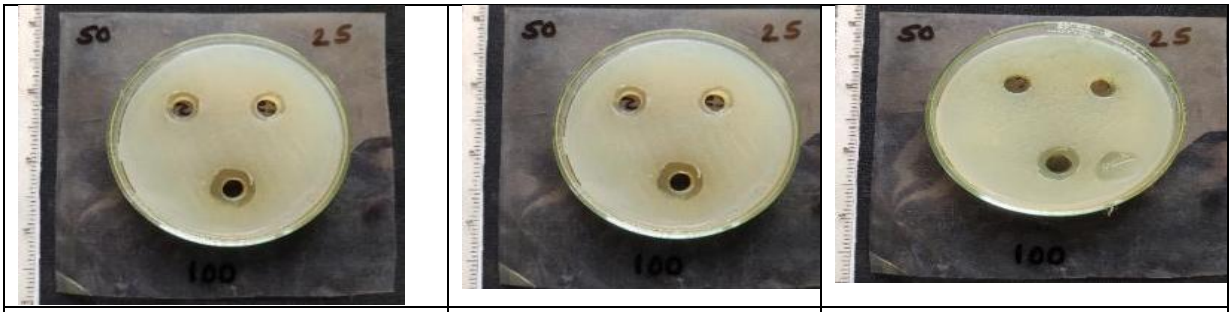
Figure 1: Zone of inhibition in mm for *E. Coli* & *S. aureus* – Control

3.2 Antibacterial Activity of *Alternanthera paronychioides*

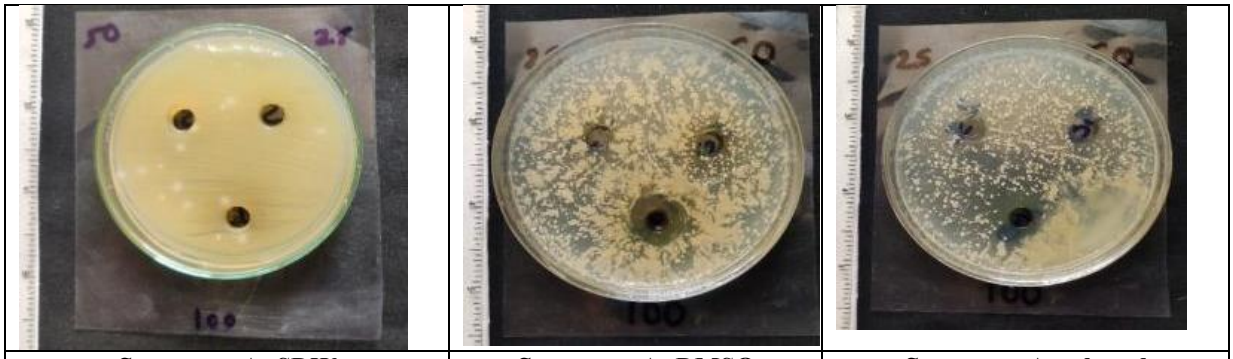
The methanolic extract of *A. paronychioides* exhibited moderate antibacterial activity. The maximum inhibition zones were 16 mm for *E. coli* and 17 mm for *S. aureus*. The activity can be attributed to secondary metabolites such as flavonoids, tannins, and alkaloids known to disrupt bacterial cell walls and interfere with nucleic acid synthesis [9]. Previous studies have reported that the Amaranthaceae family contains potent bioactive agents with bacteriostatic and bactericidal properties [10].

Table 2: Zone of inhibition of *Alternanthera paronychioides* (Sample-A) in mm for (*E. coli*) and (*S. aureus*)

	25µl	50µl	100µl
***E. coli* - Sample- A- SDW**	12	13	15
***E. coli* - Sample- A- DMSO**	NI	NI	16
***E. coli* - Sample- A- Ethanol**	NI	NI	16
	25µl	**50µl**	**100µl**
***S. aureus* - Sample-A- SDW**	NI	NI	NI
***S. aureus* - Sample-A- DMSO**	NI	NI	17
***S. aureus* - Sample-A- Ethanol**	12	12	17



***E. coli* - A- SDW**	***E. coli* - A- DMSO**	***E. coli* - A- Ethanol**



***S. aureus* - A- SDW** | ***S. aureus* - A- DMSO** | ***S. aureus* - A- ethanol**

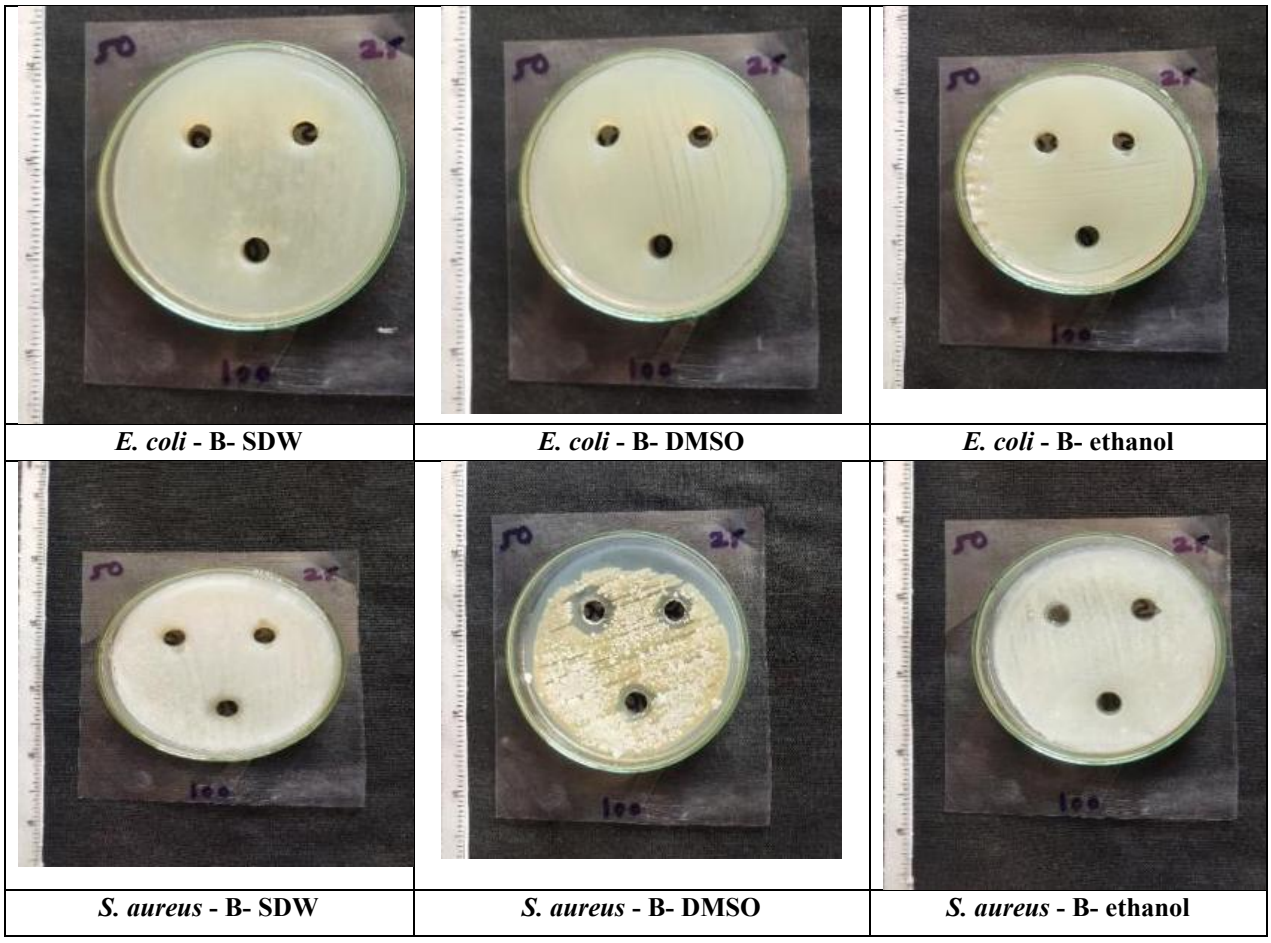
Figure 2: Zone of inhibition of *Alternanthera paronychioides* (Sample-A) in mm for (*E. coli*) and (*S. aureus*)

3.3 Antibacterial Activity of *Phoenix acaulis*

Among all tested plants, *P. acaulis* demonstrated the weakest antibacterial activity, showing no inhibition against *E. coli* and a moderate 15 mm zone against *S. aureus*. The relatively poor performance may be due to lower concentrations of bioactive phytochemicals in the methanolic fraction or the possible presence of non-polar compounds poorly soluble in methanol [14]. Nonetheless, its traditional use in local medicine warrants further study using alternative solvents.

Table 3: Zone of inhibition of *Phoenix acaulis* (Sample-B) in mm for (*E. coli*) and (*S. aureus*)

	25µl	50µl	100µl
E. coli - Sample-B- SDW	NI	NI	NI
E. coli - Sample-B- DMSO	NI	NI	NI
E. coli - Sample-B- Ethanol	NI	NI	NI
S. aureus - Sample-B- SDW	NI	NI	NI
S. aureus - Sample-B- DMSO	13	15	14
S. aureus - Sample-B- Ethanol	NI	NI	NI



***E. coli* - B- SDW** | ***E. coli* - B- DMSO** | ***E. coli* - B- ethanol**

***S. aureus* - B- SDW** | ***S. aureus* - B- DMSO** | ***S. aureus* - B- ethanol**

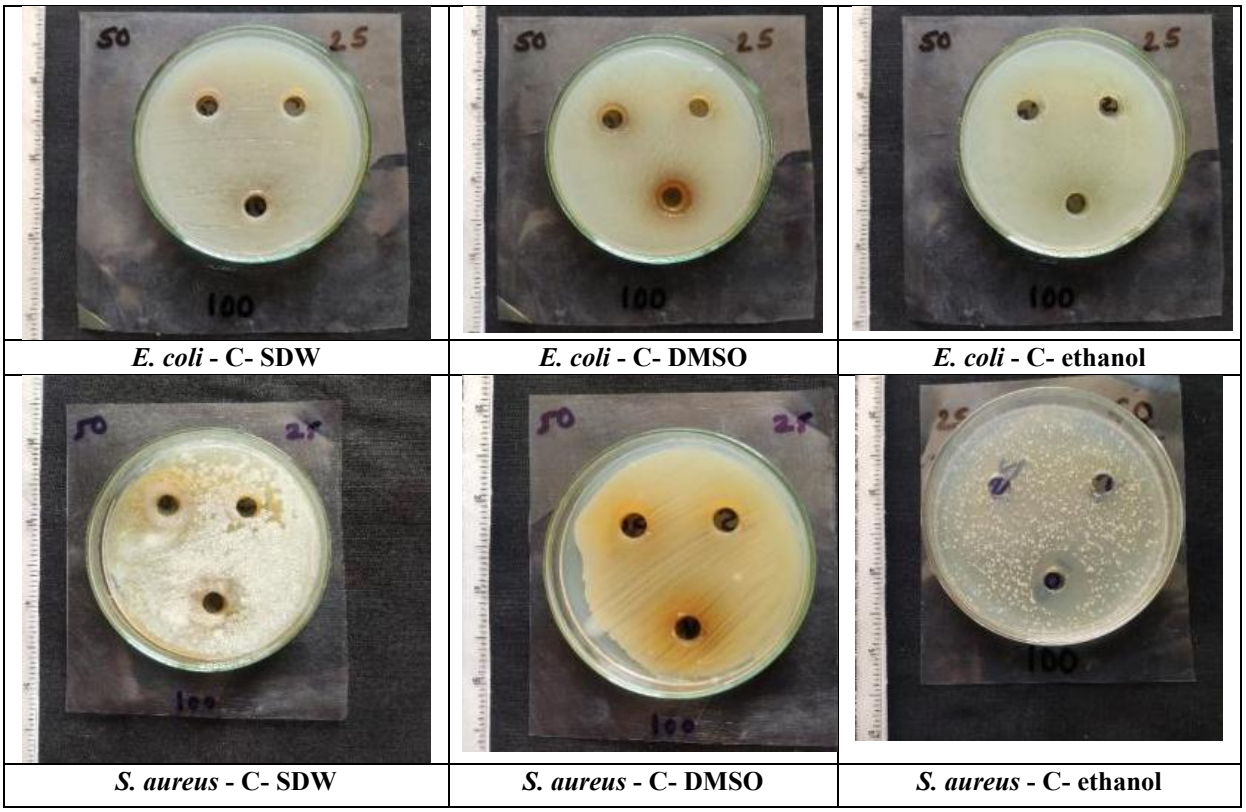
Figure 3: Zone of inhibition of *Phoenix acaulis* (Sample-B) in mm for (*E. coli*) and (*S. aureus*)

3.4 Antibacterial Activity of *Holarrhena pubescens*

The methanolic extract of *H. pubescens* demonstrated significant inhibition zones of 17 mm (*E. coli*) and 22 mm (*S. aureus*), making it one of the most effective species tested. The high antibacterial efficacy may be associated with steroidal alkaloids such as conessine and holarrhenine, which are known to cause membrane disruption and enzyme inhibition in bacterial cells [15,16]. The potent activity of *H. pubescens* reinforces its traditional use in treating gastrointestinal and infectious diseases.

Table 4: Zone of inhibition of *Holarrhena pubescens* (Sample-C) in mm for (*E. coli*) and (*S. aureus*)

	25µl	50µl	100µl
E. coli - Sample-C- SDW	NI	NI	NI
E. coli - Sample-C- DMSO	NI	13	17
E. coli - Sample-C- Ethanol	12	11	10
S. aureus - Sample-C- SDW	NI	NI	NI
S. aureus - Sample-C- DMSO	NI	NI	NI
S. aureus - Sample-C- Ethanol	NI	NI	22



***E. coli* - C- SDW** | ***E. coli* - C- DMSO** | ***E. coli* - C- ethanol**

***S. aureus* - C- SDW** | ***S. aureus* - C- DMSO** | ***S. aureus* - C- ethanol**

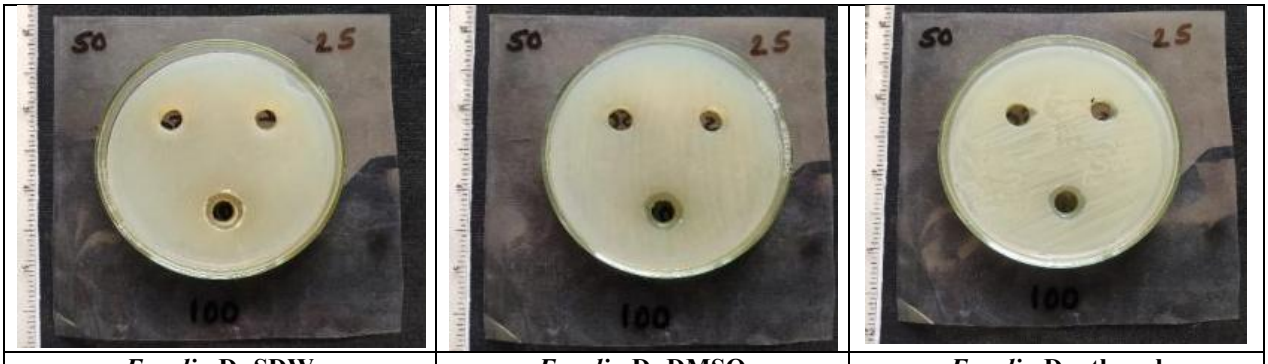
Figure 4: Zone of inhibition of *Holarrhena pubescens* (Sample-C) in mm for (*E. coli*) and (*S. aureus*)

3.5 Antibacterial Activity of *Olax psittacorum*

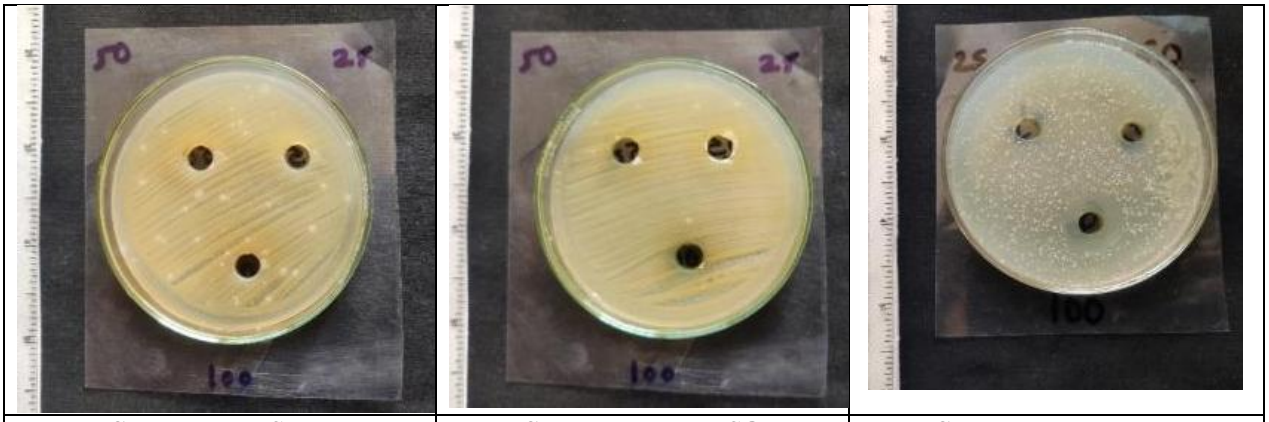
The extract of *O. psittacorum* exhibited inhibition zones of 15 mm (*E. coli*) and 21 mm (*S. aureus*). The antibacterial effect is likely due to saponins, diterpenes, and flavonoids, which interact synergistically to inhibit bacterial cell wall synthesis and protein function [17]. This species' strong inhibition of *S. aureus* underscores its potential for developing plant-based antibacterial formulations targeting Gram-positive bacteria.

Table 5: Zone of inhibition of *Olax psittacorum* (Sample-D) in mm for (*E. coli*) and (*S. aureus*)

	25µl	50µl	100µl
E. coli - Sample-D- SDW	11	NI	14
E. coli - Sample-D- DMSO	NI	NI	14
E. coli - Sample-D- Ethanol	10	13	15
S. aureus - Sample-D- SDW	NI	NI	NI
S. aureus - Sample-D- DMSO	NI	NI	NI
S. aureus - Sample-D- Ethanol	NI	16	21



***E. coli* - D- SDW** | ***E. coli* - D- DMSO** | ***E. coli* - D- ethanol**



S. aureus - D- SDW	*S. aureus* - D- DMSO	*S. aureus* - D- ethanol

Figure 5: Zone of inhibition of *Olax psittacorum* (Sample-D) in mm for (*E. coli*) and (*S. aureus*)

3.6 Comparative Analysis

The comparative results revealed significant interspecies differences (Table 6). *H. pubescens* exhibited the strongest antibacterial potential, followed by *O. psittacorum* and *A. paronychioides*. *P. acaulis* displayed limited activity. The results suggest that these wild plants, especially *H. pubescens*, contain potent antibacterial constituents warranting further phytochemical characterization.

Table 6: The comparative results and significant interspecies differences of four wild vegetables.

Plant Species	Part Used	E. coli (mm)	S. aureus (mm)	Activity Strength
Alternanthera paronychioides	Leaves	16	17	Moderate
Phoenix acaulis	Petiole	0	15	Weak
Holarrhena pubescens	Flowers	17	22	Strong
Olax psittacorum	Leaves	15	21	Strong

4. Conclusion

The comparative study demonstrates that wild edible plants from the Gadchiroli region possess significant antibacterial activity, validating their traditional use in indigenous medicine. *Holarrhena pubescens* emerged as the most effective species, indicating their potential for isolation of novel antibacterial agents. Further research should focus on bioassay-guided fractionation, compound identification, and mechanism of action studies to explore their pharmaceutical applications.

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