Int.J.Curr.Microbiol.App.Sci (2025) *14*(02): 26-34

International Journal of Current Microbiology and Applied Sciences
ISSN: 2319-7706 **Volume 14 Number 2 (2025)**
Journal homepage: http://www.ijcmas.com

Original Research Article https://doi.org/10.20546/ijcmas.2025.1402.003

Exploring the Bioactivity of *Plectranthus* species: A Sustainable Solution to Antimicrobial Resistance

Ashok B. Kadam* and Sanjay A. Kamble

Department of Botany, Shri Muktanand College, Gangapur, Maharashtra – 431109, India

**Corresponding author*

Keywords

Plectranthus Species, Plant-Based Therapeutics, Bioactive Compounds, Methanolic Extracts

Article Info

Received:
12 December 2024
Accepted:
20 January 2025
Available Online:
10 February 2025

A B S T R A C T

The escalating antimicrobial resistance (AMR) crisis necessitates innovative and sustainable solutions to address resistant pathogens. This study investigates the antimicrobial potential of five *Plectranthus* species: *Plectranthus prostratus, Plectranthus scutellarioides, Plectranthus barbatus, Plectranthus amboinicus*, and *Plectranthus caninus*. Methanolic extracts of these species were assessed for antibacterial activity against *Escherichia coli, Bacillus subtilis*, and *Salmonella Typhi* using the agar well diffusion method. The results demonstrated significant dose-dependent inhibition, with *P. amboinicus and P. barbatus* showing the most potent activity across all tested strains, achieving maximum zones of inhibition (ZOI) of 19 ± 0.5 mm and 20 ± 0.4 mm, respectively. *Bacillus subtilis* was the most susceptible strain, while *Salmonella Typhi* displayed the least sensitivity. These findings highlight the potential of *Plectranthus* species as eco-friendly alternatives to synthetic antimicrobials. Future research aimed at isolating and characterizing the bioactive compounds from these plants could enhance their therapeutic applications and contribute to developing sustainable strategies to combat AMR.

Introduction

The alarming rise of antimicrobial resistance (AMR) poses a significant global health threat, necessitating the urgent discovery of novel antimicrobial agents (Baruah *et al.,* 2024). Natural compounds, particularly from plants, offer promising alternatives to combat resistant pathogens (Woo *et al.,* 2023). These compounds exhibit diverse mechanisms of action, including protein biosynthesis inhibition and cell wall disruption (Álvarez-Martínez *et al.,* 2020). Recent research has highlighted plant-derived natural products with antibacterial, antivirulence, and antibiofilm activities (Woo *et al.,* 2023). Moreover, natural compounds can serve as adjuvants to enhance the efficacy of existing antibiotics (Guglielmi *et al.,* 2020). The development of AMR is influenced by multiple factors, including antibiotic misuse in healthcare and agriculture. Addressing this crisis requires a multifaceted approach, including surveillance, restricted antibiotic use, and improved access to quality medicines and diagnostics (Salam *et al.,* 2023).

The genus *Plectranthus*, belonging to the Lamiaceae family, is renowned for its diverse pharmacological properties and traditional medicinal uses. Species within this genus have demonstrated antimicrobial, anti-inflammatory, antioxidant, and analgesic activities (Ahamed *et al.,* 2023; Arumugam *et al.,* 2016; Kumar *et al.,* 2020). *Plectranthus* species are rich in secondary metabolites, including terpenes, flavonoids, and phenolic compounds, which contribute to their therapeutic potential (Ahamed *et al.,* 2023). Traditionally, these plants have been used to treat respiratory disorders, skin infections, and gastrointestinal ailments (Arumugam *et al.,* 2016).

Plectranthus madagascariensis and its varieties have shown promising results against microbes associated with tuberculosis and wound infections, aligning with their traditional uses. While numerous in vitro studies have been conducted, there is a need for further in vivo research, including pre-clinical and clinical trials, to fully validate the therapeutic potential of *Plectranthus* species (Lambrechts & Lall, 2020). Despite their historical use, the scientific validation of these medicinal properties, particularly their antimicrobial potential, remains underexplored for many species.

Recent studies indicate that the bioactive compounds found in *Plectranthus*, such as essential oils, phenolics, and terpenoids, demonstrate promising antimicrobial properties against a range of pathogens. These natural compounds not only inhibit microbial growth but also show potential as synergistic agents, enhancing the effectiveness of conventional antibiotics. These findings highlight the potential of *Plectranthus* species as a sustainable and eco-friendly alternative to synthetic antimicrobial agents (Rodrigues *et al.,* 2013; Silva *et al.,* 2020). This study aims to evaluate the bioactivity of selected *Plectranthus* species *Plectranthus prostratus*, *Plectranthus scutellarioides*, *Plectranthus barbatus*, *Plectranthus amboinicus*, and *Plectranthus caninus*. By investigating their antimicrobial properties, this research seeks to uncover novel solutions to the AMR crisis and contribute to the growing interest in plant-based therapeutics. Additionally, exploring these species aligns with the global efforts to develop sustainable and environmentally friendly antimicrobial strategies.

Materials and Methods

The research work was carried out at the Research Centre, Department of Botany, Shri Muktanand College, Gangapur, Maharashtra 431109. All *Plectranthus* species were collected from forest fields near the Gangapur and Sambhajinagar areas. Taxonomical identification and authentication of all species were carried out at the Botanical Survey of India, Western Regional Centre, 7 Koregaon Park, Pune by Botanist, D.L Shirodkar.

Plant Extracts Preparation

Herbal samples (1 g each) were finely powdered and extracted in 10 mL of methanol by vortexing for 10 minutes. The extracts were centrifuged at 7,000 rpm for 5 minutes to separate the supernatant.

Serial dilutions of the supernatant were prepared to achieve extract concentrations of 50 mg/mL, 100 mg/mL, and 150 mg/mL, using 100 µL of ethanol as each diluent. The prepared solutions were stored at 4°C until further use (Teng & Chen, 2022).

Antimicrobial Assay of Plant Extracts

The antimicrobial activity of plant extracts was evaluated using the agar well diffusion method on Mueller Hinton Agar (MHA) plates. MHA medium was prepared by dissolving 38 g of MHA powder in 1,000 mL of distilled water. The medium was sterilized by autoclaving at 15 psi pressure for 15 minutes. Sterilized MHA was poured into sterile petri dishes and allowed to solidify under aseptic conditions. *Escherichia coli*, *Bacillus subtilis*, and *Salmonella typhi* were cultured overnight in nutrient broth at 37°C. The turbidity of each culture was adjusted to match 0.5 McFarland standard, corresponding to an approximate cell density of 1.5×10^8 CFU/mL. The standardized microbial cultures were uniformly spread on the MHA plates using a sterile cotton swab. Wells of 6 mm diameter were created in the agar using a sterile cork borer.

Each well was filled with 50 µL of the prepared plant extracts at 50 mg/mL, 100 mg/mL, and 150 mg/mL. A positive control (1 mg/mL azithromycin) was used for bacterial assays, while methanol alone was the negative control. The plates were allowed to stand at room temperature for 30 minutes to enable diffusion of the extracts into the agar. Plates were incubated at 37°C for 18-24 hours. After incubation, the plates were examined for the formation of clear zones around the wells, indicating antimicrobial activity. The zones of inhibition (ZOI) were measured in millimeters using a ruler (Othman *et al.,* 2010).

Results and Discussion

The antimicrobial activity of methanolic extracts from five *Plectranthus* species (*P. prostratus*, *P. scutellarioides*, *P. barbatus*, *P. amboinicus*, and *P. caninus*) was evaluated against three bacterial strains (*Escherichia coli*, *Bacillus subtilis*, and *Salmonella typhi*) at three different concentrations (50, 100, and 150 mg/mL). The study compared the inhibition zones produced by these extracts with a positive control (Azithromycin at 1 mg/mL) and a negative control (methanol). Azithromycin exhibited the highest antibacterial activity across all bacterial strains, while methanol showed no inhibition, confirming the activity of the plant extracts (Table 1).

For *Escherichia coli*, all species demonstrated dose-dependent inhibition, with the zones of inhibition (ZOI) increasing with higher extract concentrations. The maximum inhibition was observed for *P. amboinicus* at 150 mg/mL (19 ± 0.5 mm), while the minimum inhibition was recorded for *P. prostratus* at 50 mg/mL (8 ± 0.3 mm). *P. scutellarioides* and *P. barbatus* showed comparable activity at 150 mg/mL, with ZOI values of 17 ± 0.5 mm and 17 ± 0.3 mm, respectively. *P. caninus* exhibited moderate activity with a maximum ZOI of 18 ± 0.3 mm at the highest concentration.

Against *Bacillus subtilis*, the extracts generally exhibited greater inhibition compared to *E. coli*. The highest inhibition was recorded for *P. barbatus* at 150 mg/mL, with a ZOI of 20 ± 0.4 mm, while the lowest was observed for *P. prostratus* at 50 mg/mL (11 ± 0.4 mm). *P. scutellarioides* and *P. amboinicus* displayed strong activity, with maximum ZOI values of 19 ± 0.4 mm and 19 ± 0.5 mm, respectively, at 150 mg/mL. Similarly, *P. caninus* achieved a ZOI of 18 ± 0.3 mm at the same concentration, demonstrating consistent antimicrobial activity across species.

In the case of *Salmonella typhi*, the inhibition zones were relatively smaller, indicating lower sensitivity of this strain to the extracts. The highest inhibition was observed for both *P. barbatus* and *P. amboinicus* at 150 mg/mL, with ZOI values of 17 ± 0.5 mm and 17 ± 0.4 mm, respectively. The lowest inhibition was recorded for *P. prostratus* at 50 mg/mL, with a ZOI of 7 ± 0.2 mm. *P. scutellarioides* and *P. caninus* showed moderate inhibition, achieving maximum ZOI values of 16 ± 0.4 mm and 16 ± 0.3 mm, respectively, at the highest concentration.

Overall, *P. barbatus* and *P. amboinicus* demonstrated the most potent antimicrobial activity across all bacterial strains, with consistently high ZOI values at higher concentrations. In contrast, *P. prostratus* exhibited the least activity, with the lowest ZOI values recorded for all strains at the lowest extract concentrations.

The sensitivity of the bacterial strains varied, with *Bacillus subtilis* being the most susceptible and *Salmonella typhi* the least. These findings underscore the potential of *Plectranthus* species, particularly *P. barbatus* and *P. amboinicus*, as sources of bioactive compounds for developing antibacterial agents.

Our findings align with previous research, which indicated that *P. amboinicus* essential oil exhibits an inhibitory effect on *E. coli* and *S. aureus* (Manjamalai, 2012). While Manjamalai (2012) stated that the essential oil is effective against *P. aeruginosa*, our results suggest otherwise. Table 1 also shows the vital oil's minimum inhibitory concentration (MIC) against bacterial and fungal pathogens. MIC is the lowest concentration inhibiting the visible growth of test organisms. *Escherichia coli* had the lowest MIC value (780 ug/ml). Multiple studies demonstrated dose-dependent inhibition, with higher extract concentrations generally resulting in increased antimicrobial activity (Elisha *et al.,* 2017).

Plectranthus scutellarioides showed strong antibacterial effects against Gram-positive bacteria, with minimum inhibitory concentrations (MIC) of 100-200 µg/ml (Rakainsa *et al.,* 2024). *Euphorbia prostrata* exhibited significant inhibition against several bacterial species, including *E. coli*. *Teucrium polium* demonstrated the lowest MIC (25 ppm) against *E. coli*, while *Peganum harmala* and *Prangos ferulaceae* required higher concentrations (100 ppm) (Jahani *et al.,* 2016).

Some plant extracts, such as *Cremaspora triflora*, showed promising antibacterial activity with relatively low cytotoxicity, suggesting potential therapeutic applications (Elisha *et al.,* 2017). These findings highlight the diverse antimicrobial properties of plant extracts and their potential as alternatives to conventional antibiotics in treating bacterial infections.

A study conducted by Rodrigues *et al.,* (2016) identified the antibacterial activity in extract of the aerial parts of *P. barbatus* against *S. aureus* however they evaluated this activity through the growth inhibition zone and the extract showed 9.03 ± 0.103 mm of inhibition.

Table.1 Antibacterial Activity of Methanolic Extracts of *Plectranthus* species against Various Bacterial Strains

Plant Species	Bacterial Strain	Extract Concentration (mg/mL)	Zone of Inhibition (ZOI) (mm)	Positive Control Azithromycin (1 mg/mL) ZOI (mm)	Negative Control (Methanol)
Plectranthus prostratus	*Escherichia coli*	50	8 ± 0.3	25 ± 0.7	0
		100	12 ± 0.4		
		150	16 ± 0.5		
	Bacillus subtilis	50	10 ± 0.3	28 ± 0.5	0
		100	14 ± 0.4		
		150	18 ± 0.3		
	Salmonella typhi	50	7 ± 0.2	24 ± 0.6	0
		100	11 ± 0.4		
		150	15 ± 0.5		
Plectranthus scutellarioides	*Escherichia coli*	50	9 ± 0.2	25 ± 0.7	0
		100	13 ± 0.4		
		150	17 ± 0.5		
	Bacillus subtilis	50	11 ± 0.4	28 ± 0.5	0
		100	15 ± 0.3		
		150	19 ± 0.4		
	Salmonella typhi	50	8 ± 0.2	24 ± 0.6	0
		100	12 ± 0.3		
		150	16 ± 0.4		
Plectranthus barbatus	*Escherichia coli*	50	10 ± 0.4	25 ± 0.7	0
		100	14 ± 0.3		
		150	18 ± 0.5		
	Bacillus subtilis	50	12 ± 0.5	28 ± 0.5	0
		100	16 ± 0.4		
		150	20 ± 0.4		
	Salmonella typhi	50	9 ± 0.3	24 ± 0.6	0
		100	13 ± 0.4		
		150	17 ± 0.5		
Plectranthus amboinicus	*Escherichia coli*	50	11 ± 0.3	25 ± 0.7	0
		100	15 ± 0.4		
		150	19 ± 0.5		
	Bacillus subtilis	50	13 ± 0.4	28 ± 0.5	0
		100	17 ± 0.5		
		150	21 ± 0.3		
	Salmonella Typhi	50	10 ± 0.3	24 ± 0.6	0
		100	14 ± 0.4		
		150	18 ± 0.5		
Plectranthus	*Escherichia*	50	9 ± 0.4	25 ± 0.7	0

caninus	*coli*	100	13 ± 0.5		
		150	17 ± 0.3		
	Bacillus subtilis	50	10 ± 0.3	28 ± 0.5	0
		100	14 ± 0.4		
		150	18 ± 0.5		
	Salmonella typhi	50	8 ± 0.2	24 ± 0.6	0
		100	12 ± 0.4		
		150	16 ± 0.3		

Figure.1 Antimicrobial Activity of *Plectranthus* species against *Escherichia coli*

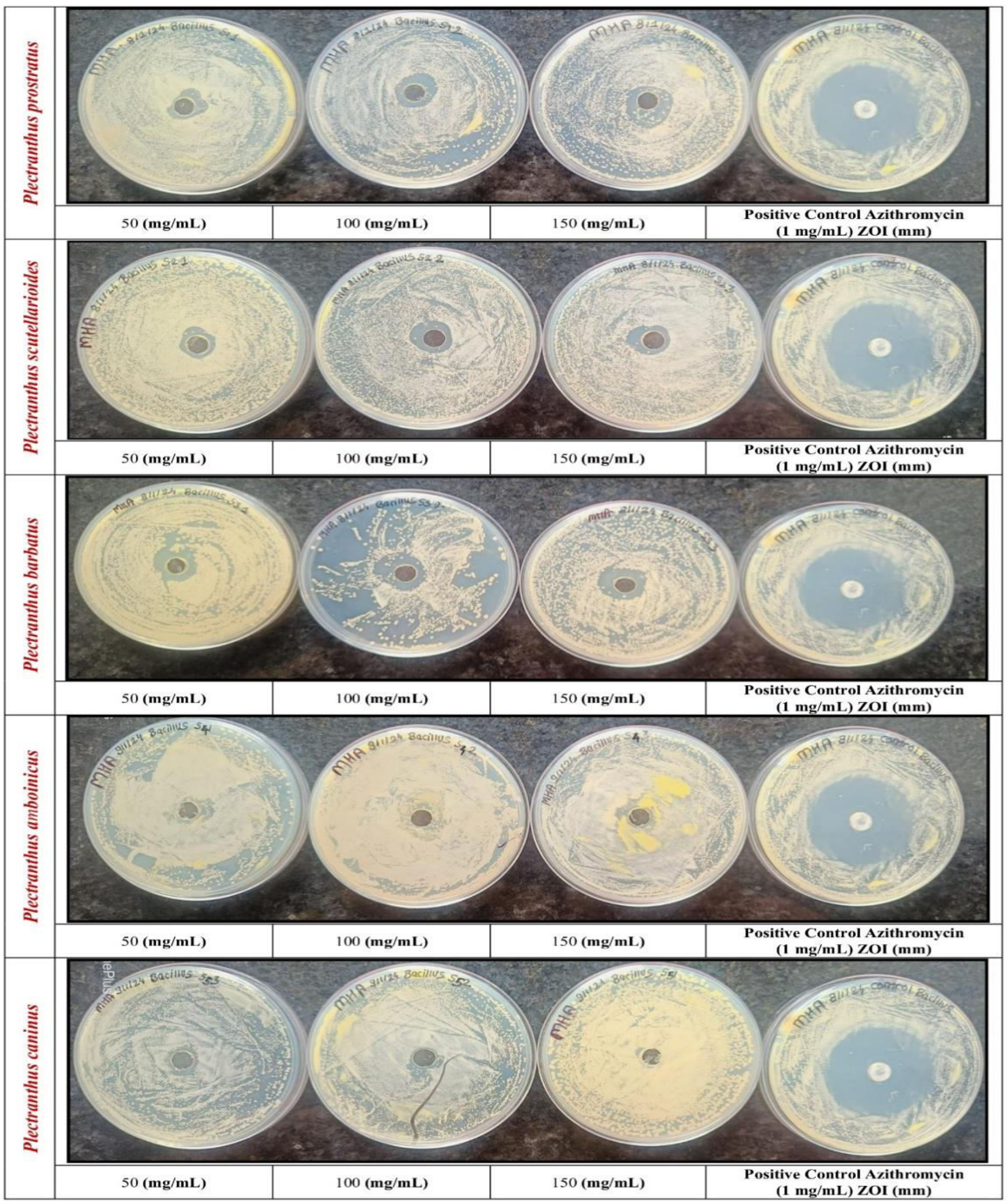
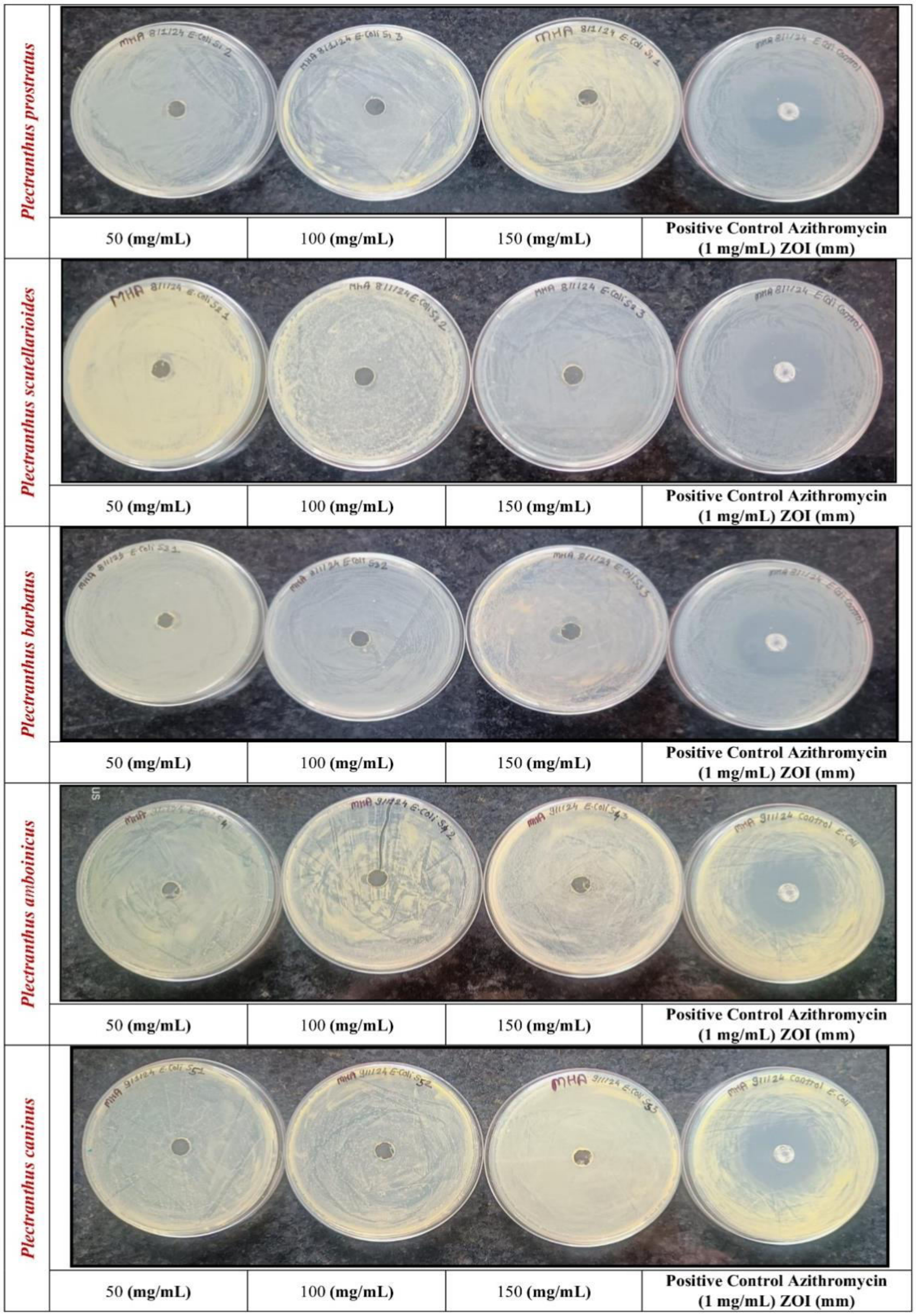


Figure.2 Antimicrobial Activity of *Plectranthus* species against *Bacillus subtilis*



In addition, these authors correlated this observation with the presence of phenolic compounds in the extract of *P. barbatus* once that the probable mechanism of action of phenolic compounds is related on bacterial cytoplasmic membrane. Matu and Van Staden (2003) used the aqueous, hexanic and methanolic extracts of *P. barbatus* leaves to identify their actions against gram-positive bacteria (*Bacillus subtilis*, *Micrococcus luteus, Staphylococcus aureus*) and gram-negative (*E. coli* and *K. pneumoniae*) bacteria. At their study it was identified that the methanolic extract showed activity against all Gram-positive isolates. However, Santos Veríssimo *et al.,* (2014) identified the antibacterial activity of the crude ethanol extract of *P. barbatus* leaves against *E. coli* showing a MIC = 6250 µg.mL-1 and also against *Staphylococcus aureus* (MIC = 3120 µg.mL-1). Araújo *et al.,* (2014) also evaluated the antibacterial action of the leaf extract of *P. barbatus*, which presented bacteriostatic activity against E. coli (MIC = 250 µg.mL-1, MBC > 2000 µg.mL-1) and *P. aeruginosa* (MIC = 250 µg.mL-1, MBC = 2000 µg.mL-1).

Several studies have investigated the antimicrobial effects of plant extracts on *Salmonella typhi*, the causative agent of typhoid fever. *Plectranthus amboinicus* (bangun-bangun leaves) extract demonstrated inhibitory effects against *S. typhi*, with a 25% concentration producing the largest inhibition zone (Yulizal *et al.,* 2020). Similarly, *Anredera cordifolia* (binahong) leaf extract inhibited *S. typhi* growth (Saputera *et al.,* 2013). *Phyllanthus amarus* ethanolic extract showed strong antimicrobial activity against *S. typhi*, comparable to ciprofloxacin (Oluwafemi & Debiri, 2010). Our data corroborate with these authors regarding the greater activity of the organic extract compared to the aqueous one to pathogenic bacteria.

The study demonstrated that methanolic extracts of *Plectranthus* species exhibit significant antibacterial activity against *Escherichia coli*, *Bacillus subtilis*, and *Salmonella typhi*. Among the five species tested, *Plectranthus amboinicus* and *Plectranthus* barbatus consistently displayed the most potent antimicrobial activity, with larger zones of inhibition at higher extract concentrations.

Bacillus subtilis was the most susceptible bacterial strain, while *Salmonella typhi* exhibited the least sensitivity to the extracts. These findings highlight the potential of *Plectranthus* species, particularly *P. amboinicus* and *P. barbatus*, as promising sources of bioactive compounds for developing alternative antibacterial agents.

Future studies focusing on the isolation and characterization of specific bioactive components could provide further insights into their mechanisms of action and therapeutic applications.

Acknowledgement

The authors extend their gratitude to the Principal of the Research Centre, Department of Botany, Shri Muktanand College, Gangapur, for providing laboratory facilities, and to the research supervisor for their invaluable guidance. Additionally, the authors acknowledge Progenome Laboratory Services, Chha. Sambhajinagar for the confirmation of the research findings and technical support.

Author Contributions

Ashok B. Kadam: Investigation, formal analysis, writing—original draft. Sanjay A. Kamble: Validation, methodology, writing—reviewing.

Data Availability

The datasets generated during and/or analyzed during the current study are available from the corresponding author on reasonable request.

Declarations

Ethical Approval Not applicable.

Consent to Participate Not applicable.

Consent to Publish Not applicable.

Conflict of Interest The authors declare no competing interests.

References

Ahamed, A. N., Yaser, S. M., Idhris, S. M., Padusha, M. S. A., & Sherif, N. A. (2023). Phytochemical and pharmacological potential of the genus *Plectranthus*—A review. *South African Journal of Botany*, *154*, 159–189. https://doi.org/10.1016/j.sajb.2023.01.026

Álvarez-Martínez, F. J., Barrajón-Catalán, E., & Micol, V. (2020). Tackling Antibiotic Resistance with Compounds of Natural Origin: A Comprehensive Review. *Biomedicines*, *8*(10), 405. https://doi.org/10.3390/biomedicines8100405

Araújo, S. G., Alves, L. F., Pinto, M. E. A., Oliveira, G. T., Siqueira, E. P., Ribeiro, R. I. M. A., Ferreira, J. M. S., & Lima, L. a. R. S. (2014). Volatile compounds of Lamiaceae exhibit a synergistic antibacterial activity with streptomycin. *Brazilian Journal of Microbiology*, *45*(4), 1341–

1347. https://doi.org/10.1590/s1517-83822014000400026

Arumugam, G., Swamy, M., & Sinniah, U. (2016). *Plectranthus amboinicus* (Lour.) Spreng: Botanical, Phytochemical, Pharmacological and Nutritional Significance. *Molecules*, *21*(4), 369. https://doi.org/10.3390/molecules21040369

Baruah, J., Singh, L. S., Salvia, T., & Sarma, J. (2024). Antimicrobial resistance a continued global threat to public health – A perspective and mitigation strategies. *Journal of Laboratory Physicians*, *0*, 1–12. https://doi.org/10.25259/jlp_24_2024

Elisha, I. L., Botha, F. S., McGaw, L. J., & Eloff, J. N. (2017). The antibacterial activity of extracts of nine plant species with good activity against *Escherichia coli* against five other bacteria and cytotoxicity of extracts. *BMC Complementary and Alternative Medicine*, *17*(1). https://doi.org/10.1186/s12906-017-1645-z

Guglielmi, P., Pontecorvi, V., & Rotondi, G. (2020). Natural compounds and extracts as novel antimicrobial agents. *Expert Opinion on Therapeutic Patents*, *30*(12), 949–962. https://doi.org/10.1080/13543776.2020.1853101

Jahani, S., Saeidi, S., Javadian, F., Akbarizadeh, Z., & Sobhanizade, A. (2016). Investigating the Antibacterial Effects of Plant Extracts on *Pseudomonas aeruginosa* and *Escherichia coli. International Journal of Infection*, *3*(2). https://doi.org/10.17795/iji-34081

Kumar, P., Singh, S., & Kumar, N. (2020). *Plectranthus amboinicus*: a review on its pharmacological and, pharmacognostical studies. *American Journal of Physiology Biochemistry and Pharmacology*, *10*(2), 55–62. https://doi.org/10.5455/ajpbp.20190928091007

Lambrechts, I. A., & Lall, N. (2020). Traditional usage and biological activity of *Plectranthus madagascariensis* and its varieties: A review. *Journal of Ethnopharmacology*, *269*, 113663. https://doi.org/10.1016/j.jep.2020.113663

Manjamalai A, Berlin Grace VM. Antioxidant activity of essential oils from Wedelia chinensis (Osbeck) in vitro and in vivo lung cancer bearing C57BL/6 mice. Asian Pac J Cancer Prev. 2012;13(7):3065-71. https://doi.org/10.7314/apjcp.2012.13.7.3065

Matu E.N. and Van Staden, J. (2003) Antibacterial and anti-inflammatory activities of some plants used for medicinal purposes in Kenya. *Journal of Ethnopharmacology,* 87(1): 35-41. https://doi.org/10.1016/s0378-8741(03)00107-7

Oluwafemi, F. and Debiri, F. 2010. Antimicrobial effect of *Phyllanthus amarus* and *Parquetina nigrescens* on *Salmonella typhi*. African Journal of Biomedical Research, 11: 215-219.

Othman, M., Loh, H. S., Wiart, C., Khoo, T. J., Lim, K. H., & Ting, K. N. (2010). Optimal methods for evaluating antimicrobial activities from plant extracts. *Journal of Microbiological Methods*, *84*(2), 161–166. https://doi.org/10.1016/j.mimet.2010.11.008

Rakainsa, S. K., Nisa, K., Ito, T., & Morita, H. (2024). Antibacterial activity of five Indonesian medicinal plants and the isolation of compounds from *Plectranthus scutellarioides*. *Journal of Applied Pharmaceutical Science*. https://doi.org/10.7324/japs.2024.167320

Rodrigues TM, Castro Caldas A, Ferreira JJ. 2016. Pharmacological interventions for daytime sleepiness and sleep disorders in Parkinson's disease: Systematic review and meta-analysis. Parkinsonism Relat Disord. 27:25-34. https://doi.org/10.1016/j.parkreldis.2016.03.002

Rodrigues, F. F. G., Costa, J. G. M., Rodrigues, F. F. G., & Campos, A. R. (2013). Study of the Interference between *Plectranthus* Species Essential Oils from Brazil and Aminoglycosides. *Evidence-based Complementary and Alternative Medicine*, *2013*, 1–7. https://doi.org/10.1155/2013/724161

Salam, M. A., Al-Amin, M. Y., Salam, M. T., Pawar, J. S., Akhter, N., Rabaan, A. A., & Alqumber, M. a. A. (2023). Antimicrobial resistance: a growing serious threat for global public health. *Healthcare*, *11*(13), 1946. https://doi.org/10.3390/healthcare11131946

Saputera. Katerisasi Biji Kamandrah. 2013. (Croton tigliumL.) dan Pengembangan Teknologi Proses Ekstrak Terstandar Sebagai Bahan Laksatif. [skripsi]. Bogor: Sekolah Pascasarjana Institut Pertanian Bogor.

Silva, J. M. D. S., Da Silva Almeida, J. R. G., Alves, C. D. S. C., Nery, D. A., Damasceno, L. M. O., De Souza Araújo, C., Rolim, L. A., & De Oliveira, A. P. (2020). Antimicrobial Activity from Species *Plectranthus amboinicus* (Lour.) Spreng, a Review. *European Journal of Medicinal Plants*, 1–14. https://doi.org/10.9734/ejmp/2020/v31i1830337

Teng, T. S., & Chen, W. W. N. (2022). Bioactivities of liuwei dihuang extracts and its role in the treatment of diabetes. *Advances in Biotechnology & Microbiology*, *16*(5). https://doi.org/10.19080/aibm.2022.16.555949

Veríssimo, R. C. S. S., Lins, T. H., De Assis Bastos, M. L., De Albuquerque Sarmento, P., Alvino, V., Araujo, M. G. S., Silva, A. L. L., & Araújo-Júnior, J. X. (2014). Antimicrobial activity of *Plectranthus barbatus* (Lamiacea). *BMC Proceedings*, *8*(S4). https://doi.org/10.1186/1753-6561-8-S4-P264

Woo, S., Marquez, L., Crandall, W. J., Risener, C. J., & Quave, C. L. (2023). Recent advances in the discovery of plant-derived antimicrobial natural products to combat antimicrobial resistant pathogens: insights from 2018–2022. *Natural Product Reports*, *40*(7), 1271–1290. https://doi.org/10.1039/d2np00090c

Yulizal OK, Lelo A, Ilyas S, Kusumawati RL. The effect of Channa striata extract and standard eradication regimen on asymmetric dimethylarginine in Helicobacter pylori gastritis rat model. Vet World. 2020 Aug;13(8):1605-1612. https://doi.org/10.14202/vetworld.2020.1605-1612

How to cite this article:

Ashok B. Kadam and Sanjay A. Kamble. 2025. Exploring the Bioactivity of *Plectranthus* Species: A Sustainable Solution to Antimicrobial Resistance. *Int.J.Curr.Microbiol.App.Sci.* 14(02): 26-34.
doi: https://doi.org/10.20546/ijcmas.2025.1402.003