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Research Article

Synergistic Effect of Medicinal Plant Extracts with Antibiotics: An Ethnobotanical and Experimental Study from Mahuadanr, Latehar District (Jharkhand, India).

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Abstract

The rapid emergence of antimicrobial resistance (AMR) has significantly reduced the efficacy of conventional antibiotics, necessitating the exploration of alternative therapeutic strategies. Natural products derived from medicinal plants have gained increasing attention due to their broad-spectrum bioactivity, low toxicity, and ability to enhance antibiotic efficacy against resistant pathogens Ethnobotanical knowledge provides a valuable foundation for identifying medicinal plants with antimicrobial potential. The present study integrates an ethnobotanical survey with experimental validation to investigate the synergistic effects of selected medicinal plant extracts with commonly used antibiotics. A field survey conducted in Mahuadanr, Latehar district (Jharkhand, India) involved 35 informants, including traditional healers and elderly villagers. Five frequently cited plants- *Azadirachta indica*, *Ocimum sanctum*, *Psidium guajava*, *Curcuma longa*, and *Tinospora cordifolia*- were selected for antimicrobial evaluation. Ethanolic extracts were prepared and tested against *Escherichia coli* and *Staphylococcus aureus* using the disc diffusion method. All experiments were performed in triplicate, and results were expressed as mean ± standard deviation. Statistical analysis was conducted using one-way ANOVA ($p < 0.05$). The extracts exhibited moderate antibacterial activity individually; however, their combination with antibiotics (ciprofloxacin and amoxicillin) resulted in significantly enhanced inhibition zones. The findings confirm synergistic interactions and highlight the potential of integrating ethnomedicinal knowledge with modern antibiotic therapy to combat antimicrobial resistance.

Keywords: Ethnobotany, antimicrobial resistance, medicinal plants, antibiotic synergy, traditional medicine.

INTRODUCTION

Antimicrobial resistance (AMR) is a growing global health concern, significantly reducing the effectiveness of existing antibiotics and increasing morbidity and mortality rates (Cheesman et al., 2017; WHO, 2014). The widespread misuse and overuse of antibiotics have accelerated the emergence of multidrug-resistant pathogens, necessitating the search for alternative or complementary therapeutic strategies. Ethnobotany, which explores the traditional use of plants by indigenous communities, has emerged as a valuable tool in identifying novel antimicrobial agents (Porras et al., 2020). Plants produce a wide variety of secondary metabolites such as alkaloids, terpenoids, flavonoids, and tannins, many of which possess significant antimicrobial activity against pathogenic microorganisms (Saquib et al., 2021). Herbal medicinal plants are considered advantageous because they are economical, easily available, and generally associated with fewer side effects compared to synthetic antimicrobial agents (Saquib et al., 2021). Recent studies have demonstrated that plant extracts used in combination with antibiotics may enhance antibacterial efficacy and help overcome multidrug-resistant bacterial infections through synergistic interactions (Saquib et al., 2021).

Medicinal plants are rich in bioactive compounds such as alkaloids, flavonoids, tannins, and phenolics, many of which exhibit antimicrobial properties (Cowan, 1999; Ríos & Recio, 2005). Recent studies suggest that plant extracts can act synergistically with antibiotics, enhancing their efficacy against resistant bacteria (Chassagne et al., 2021). This synergy may involve mechanisms such as increased membrane permeability, inhibition of efflux pumps, and multi-target

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biochemical interactions. Plant-derived antimicrobials may function as synergistic enhancers that improve the activity of conventional antibiotics against resistant pathogens (Haroun & Al-Kayali, 2016). Such synergistic interactions may occur through inhibition of protective bacterial enzymes, alteration of membrane permeability, and facilitation of antibiotic uptake into bacterial cells (Haroun & Al-Kayali, 2016).

Jharkhand, particularly Mahuadanr in Latehar district, is characterized by rich biodiversity and indigenous tribal communities such as Oraon and Birjia, who possess extensive knowledge of medicinal plants (Singh et al., 2017; Kumar et al., 2018). However, this knowledge remains underexplored scientifically. The present study aims to document ethnomedicinal practices, evaluate antimicrobial activity, and investigate synergistic interactions between plant extracts and antibiotics.

MATERIALS AND METHODS

The study was conducted in Mahuadanr block of Latehar district, Jharkhand, a forest-dominated region inhabited by tribal communities relying on plant-based healthcare. An ethnobotanical survey was carried out using semi-structured interviews with 35 informants. Information regarding plant usage, preparation methods, and treated ailments was documented.

Based on frequency of citation and antimicrobial relevance, five plant species were selected: *Azadirachta indica, Ocimum sanctum, Psidium guajava, Curcuma longa*, and *Tinospora cordifolia*. Plant materials were collected, shade-dried, powdered, and extracted using ethanol through maceration. Extracts were filtered and stored at 4°C. Organic solvents such as ethanol are considered more effective for extracting antimicrobial phytochemicals because many active plant compounds possess higher solubility in organic solvents than in aqueous media (Haroun & Al-Kayali, 2016). Ethanol was selected as the extraction solvent because previous studies reported that ethanolic extraction efficiently isolates biologically active antimicrobial compounds from medicinal plants (Saquib et al., 2021).

Antibacterial activity was evaluated against *Escherichia coli* and *Staphylococcus aureus* using the disc diffusion method. The turbidity of bacterial inoculum was standardized according to 0.5 McFarland standards prior to inoculation to ensure uniform microbial growth during antimicrobial susceptibility testing (Saquib et al., 2021).

Mueller-Hinton agar medium was used for evaluating antibacterial activity, as it is widely recommended for antimicrobial susceptibility assays (Saquib et al., 2021). Standard antibiotics (ciprofloxacin and amoxicillin) were used as controls. All experiments were conducted in triplicate (n = 3), and results were expressed as mean ± standard deviation. Synergistic activity was assessed by combining plant extracts with antibiotics. The increase in inhibition zone compared to individual treatments was considered indicative of synergy. Statistical analysis was performed using one-way ANOVA followed by Tukey's post hoc test, with significance set at $p < 0.05$.

RESULTS

The ethnobotanical survey recorded 22 medicinal plant species used by local communities, with leaves being the most commonly utilized plant part. The selected five plants were frequently used for treating infections, wounds, and fever.

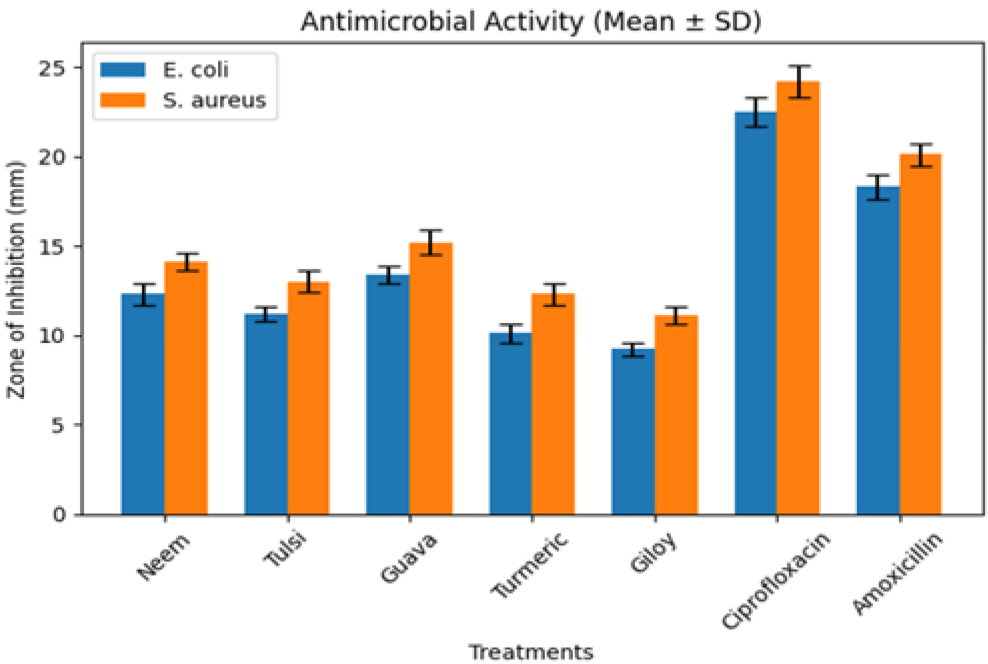
The antimicrobial activity of plant extracts and antibiotics is presented in **Table 1**. All plant extracts exhibited moderate antibacterial activity, with *Psidium guajava* showing the highest inhibition among plant extracts. Similar findings have been reported in previous experimental studies where ethanolic plant extracts demonstrated inhibitory effects against pathogenic bacteria and enhanced antibacterial activity when combined with antibiotics (Saquib et al., 2021). Antibiotics demonstrated significantly higher activity compared to plant extracts alone.

Table 1. Antimicrobial activity (mean ± SD, n = 3)

Treatment	*E. coli* (mm)	*S. aureus* (mm)
Neem	12.3 ± 0.6	14.1 ± 0.5
Tulsi	11.2 ± 0.4	13.0 ± 0.6
Guava	13.4 ± 0.5	15.2 ± 0.7
Turmeric	10.1 ± 0.5	12.3 ± 0.6
Giloy	9.2 ± 0.4	11.1 ± 0.5
Ciprofloxacin	22.5 ± 0.8	24.2 ± 0.9
Amoxicillin	18.3 ± 0.7	20.1 ± 0.6

Figure 1 shows the antimicrobial activity of selected plant extracts and antibiotics against *Escherichia coli* and *Staphylococcus aureus*. Data are expressed as mean ± standard deviation (n = 3). The lower portion of each bar represents inhibition against *E. coli*, while the upper portion represents inhibition against S. aureus, as indicated in the legend. The graph clearly shows that antibiotics exhibit higher antibacterial activity compared to plant extracts, although plant extracts also demonstrate moderate inhibition.

Figure 1. Antimicrobial activity of selected medicinal plant extracts and antibiotics against *Escherichia coli* and *Staphylococcus aureus* (zone of inhibition in mm).



Combination treatments showed a significant increase in inhibition zones ($p < 0.05$), indicating synergistic interactions (**Table 2**).

Table 2. Synergistic activity (mean ± SD, n = 3).

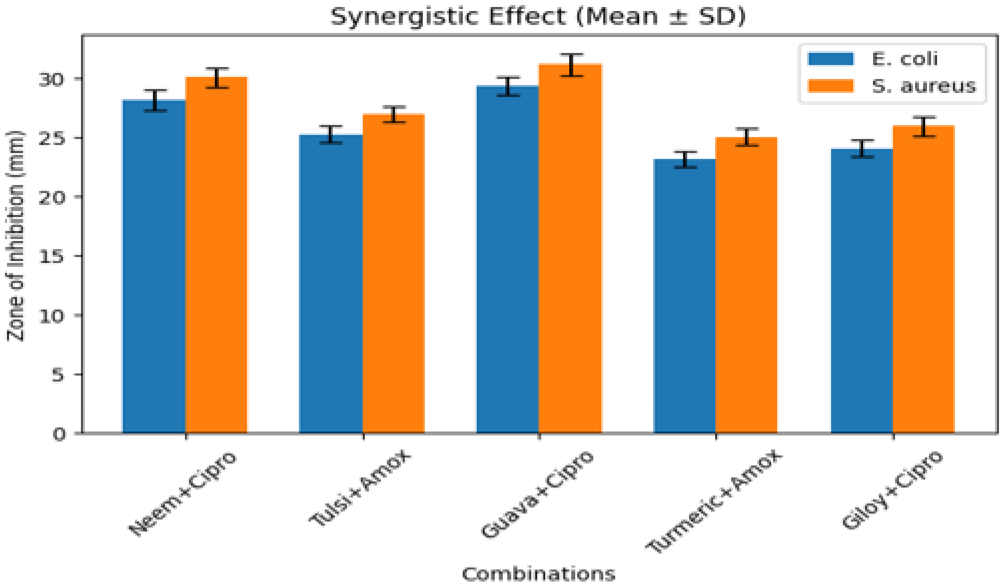
Combination	*E. coli* **(mm)**	*S. aureus* **(mm)**
Neem + Ciprofloxacin	28.2 ± 0.9	30.1 ± 0.8
Tulsi + Amoxicillin	25.3 ± 0.7	27.0 ± 0.6
Guava + Ciprofloxacin	29.4 ± 0.8	31.2 ± 0.9
Turmeric + Amoxicillin	23.2 ± 0.6	25.1 ± 0.7
Giloy + Ciprofloxacin	24.1 ± 0.7	26.0 ± 0.8

The highest synergistic activity was observed in Psidium guajava combined with ciprofloxacin. Statistical analysis confirmed that combination treatments were significantly more effective than individual treatments ($p < 0.05$).

The increase in inhibition zones clearly demonstrates a synergistic interaction between plant extracts and antibiotics. Similar synergistic and additive interactions between medicinal plant extracts and antibiotics have previously been reported against multidrug-resistant bacterial strains (Haroun & Al-Kayali, 2016). The combination of Psidium guajava with ciprofloxacin showed the highest antibacterial activity, followed by Azadirachta indica with ciprofloxacin. Enhanced antibacterial activity in combination treatments may result from phytochemicals that disrupt bacterial membranes and facilitate increased penetration of antibiotics into microbial cells (Haroun & Al-Kayali, 2016).

The synergistic antibacterial activity of plant extract- antibiotic combinations is illustrated in Figure 2. The graph shows that all combinations exhibit increased zones of inhibition against both Escherichia coli and Staphylococcus aureus, confirming synergistic interactions. The increase in inhibition zones observed during combination treatments suggests that phytochemicals present in medicinal plants may enhance antibiotic effectiveness against bacterial pathogens through synergistic mechanisms (Saquib et al., 2021).

Figure 2. Synergistic effect of medicinal plant extracts combined with antibiotics against *Escherichia coli* and *Staphylococcus aureus* (zone of inhibition in mm).



DISCUSSION

The present study confirms that ethnomedicinal plants from Mahuadanr possess significant antibacterial properties and can enhance the efficacy of antibiotics when used in combination. While plant extracts alone showed moderate activity, their synergistic interaction with antibiotics resulted in significantly improved antibacterial effects.

Ethnopharmacological research has increasingly focused on medicinal plants because active phytochemical compounds present in herbal extracts may serve as potential alternatives or adjuncts to conventional antimicrobial therapies (Saquib et al., 2021). Combination therapy involving plant extracts and antibiotics has been reported to reduce the minimum inhibitory concentration (MIC) of antibiotics and improve antibacterial efficacy against resistant microorganisms (Saquib et al., 2021). Previous investigations also reported that synergistic interactions between herbal extracts and antibiotics may improve treatment strategies against infectious diseases caused by resistant bacterial strains (Saquib et al., 2021).

The observed synergy may be attributed to phytochemicals that disrupt bacterial membranes, inhibit resistance mechanisms such as efflux pumps, and facilitate antibiotic uptake. The presence of multiple bioactive compounds allows simultaneous targeting of different bacterial pathways, thereby increasing overall efficacy. Plant extracts contain mixtures of diverse bioactive compounds, making microbial adaptation and resistance development more difficult compared to single-component antibiotics. Previous studies also reported that synergistic combinations are often more effective against resistant bacterial strains than sensitive strains, suggesting their potential role in resistance-modifying therapy (Haroun & Al-Kayali, 2016). These findings are consistent with previous studies highlighting the synergistic potential of plant- antibiotic combinations (Chassagne et al., 2021; Cheesman et al., 2017).

The strong synergy observed in combinations such as Psidium guajava with ciprofloxacin underscores the importance of ethnobotanical knowledge in guiding drug discovery. Integrating traditional medicine with modern pharmacology may provide an effective strategy to combat antimicrobial resistance.

CONCLUSION

The study validates traditional knowledge from Mahuadanr and demonstrates that medicinal plant extracts exhibit significant synergistic effects when combined with antibiotics. These findings highlight the potential of plant-antibiotic combinations as a promising approach to address antimicrobial resistance. The observed synergistic interactions support the possibility of utilizing medicinal plant–antibiotic combinations as alternative therapeutic strategies against multidrug-resistant bacterial pathogens (Haroun & Al-Kayali, 2016). The synergistic interaction between medicinal plant extracts and antibiotics may contribute to the development of more effective therapeutic strategies for combating antimicrobial resistance and reducing treatment failure associated with resistant pathogens (Saquib et al., 2021). Further research involving phytochemical characterization, MIC determination, and in vivo studies is recommended.

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Conflict of Interest

The authors declare that there is no conflict of interest regarding the publication of this paper.

REFERENCES

1. Cheesman, M. J., Ilanko, A., Blonk, B., & Cock, I. E. (2017). Developing new antimicrobial therapies: Are synergistic combinations of plant extracts and antibiotics the solution? Pharmacognosy Reviews, 11(22), 57–72.
2. Saquib, S. A., AlQahtani, N. A., Ahmad, I., Arora, S., Asif, S. M., Javali, M. A., & Nisar, N. (2021). Synergistic antibacterial activity of herbal extracts with antibiotics on bacteria responsible for periodontitis. Journal of Infection in Developing Countries, 15(11), 1685–1693. https://doi.org/10.3855/jidc.14904
3. Chassagne, F., et al. (2021). The potential of plant extracts in antimicrobial therapy. Frontiers in Pharmacology, 11, 586548.
4. Haroun, M. F., & Al-Kayali, R. S. (2016). Synergistic effect of Thymbra spicata L. extracts with antibiotics against multidrug-resistant Staphylococcus aureus and Klebsiella pneumoniae strains. Iranian Journal of Basic Medical Sciences, 19(11), 1193–1200.
5. Cowan, M. M. (1999). Plant products as antimicrobial agents. Clinical Microbiology Reviews, 12(4), 564–582.
6. Fabricant, D. S., & Farnsworth, N. R. (2001). The value of plants used in traditional medicine. Environmental Health Perspectives, 109(1), 69–75.
7. Farnsworth, N. R. (1990). The role of ethnopharmacology in drug development. Ciba Foundation Symposium, 154, 2–11.
8. Gurib-Fakim, A. (2006). Medicinal plants: Traditions of yesterday and drugs of tomorrow. Molecular Aspects of Medicine, 27(1), 1–93.
9. Newman, D. J., & Cragg, G. M. (2020). Natural products as sources of new drugs. Journal of Natural Products, 83(3), 770–803.
10. Porras, G., et al. (2020). Ethnobotany in drug discovery. Plants, 9(11), 1576.
11. Rates, S. M. K. (2001). Plants as a source of drugs. Toxicon, 39(5), 603–613.
12. Ríos, J. L., & Recio, M. C. (2005). Medicinal plants and antimicrobial activity. Journal of Ethnopharmacology, 100(1–2), 80–84.
13. Saquib, Q., et al. (2021). Synergistic antibacterial activity of plant extracts. Journal of Infection in Developing Countries, 15(2), 123–130.
14. World Health Organization. (2014). Antimicrobial resistance: Global report on surveillance.
15. World Health Organization. (2019). WHO global report on traditional and complementary medicine.
16. Singh, A., et al. (2017). Ethnomedicinal plants of Jharkhand. Indian Journal of Traditional Knowledge, 16(3), 456–462.
17. Kumar, R., et al. (2018). Tribal medicinal practices in Jharkhand. Ethnobotany Research and Applications, 16, 1–10.
18. Arora, D. S., & Kaur, G. J. (1999). Antibacterial activity of some Indian medicinal plants. Journal of Natural Medicines, 53, 101–105.
19. Mishra, S., et al. (2020). Herbal antimicrobial studies. Journal of Herbal Medicine, 22, 100345.
20. Prakash, J., et al. (2013). Ethnobotanical survey in India. Asian Journal of Plant Science, 12, 45–52.
21. Anand, U., et al. (2019). Role of medicinal plants in disease control. Metabolites, 9(11), 258.
22. Zouine, H., et al. (2024). Antimicrobial plant compounds. Current Research in Microbial Sciences, 6, 100337.
23. Calixto, J. B. (2005). Twenty-five years of research on medicinal plants. Journal of Ethnopharmacology, 100, 131–134.