

A Systematic Review on Antimicrobial Activity of Piper Betle Linn Leaves**Afroj A. Shaikh^{*1}, Dhanashri D. Shejul¹, Mahesh P. Shekade¹, Sachin J. Anbhule²**¹Department of Pharmacy, HSBPVT'S, GOI, College of Pharmacy, Kashti, Shrigonda 413701, Maharashtra, India²Department of Pharmaceutical Chemistry, HSBPVT'S, GOI, College of Pharmacy, Kashti, Shrigonda 413701, Maharashtra, India *ORCID ID: <https://orcid.org/0000-0001-9189-9848>**ABSTRACT**

Piper betle Linn (PBL) is a well-known medicinal plant used in traditional medicine for various ailments. The leaves of P. betle Linn have been reported to exhibit broad-spectrum antimicrobial activity against various pathogenic microorganisms. The major active compounds responsible for the antimicrobial activity of P. betle Linn are phenolics, alkaloids, terpenoids, and flavonoids. This review article aims to summarize the current knowledge on the antimicrobial activity of P. betle Linn leaf extracts against bacteria, fungi, viruses, and parasites. The article also discusses the major active compounds responsible for the antimicrobial activity of P. betle Linn and their mechanism of action. Further, the potential use of P. betle Linn as a natural antimicrobial agent to combat antimicrobial resistance (AMR) is discussed. The review highlights the need for further studies to evaluate the efficacy and safety of P. betle Linn extracts as a potential antimicrobial agent.

Keywords: PBL, antimicrobial activity, phenolics, alkaloids, terpenoids, flavonoids, mechanism of action, antimicrobial resistance.

INTRODUCTION

Antimicrobial resistance (AMR) is a global public health threat that has led to the emergence of multidrug-resistant (MDR) microorganisms. The development of new antimicrobial agents is crucial to combat AMR and protect public health. Medicinal plants have been used for centuries in traditional medicine to treat various ailments, including infectious diseases. The leaves of *P. betle Linn*, a member of the Piperaceae family, have been used in traditional medicine for their antimicrobial, anti-inflammatory, and analgesic properties. *P. betle Linn* is a climbing vine that is widely distributed in Southeast Asia, India, and China. The leaves of *P. betle Linn* contain various bioactive compounds, including phenolics, alkaloids, terpenoids, and flavonoids, which have been reported to exhibit antimicrobial activity against various pathogenic microorganisms.

- **Antibacterial Activity**

P. betle Linn leaf extracts have been reported to exhibit antibacterial activity against various pathogenic bacteria,

including *Staphylococcus aureus*, *Escherichia coli*, *Salmonella typhi*, and *Pseudomonas aeruginosa*. The antibacterial activity of *P. betle Linn* is attributed to its phenolic and alkaloid content. The phenolic compounds present in *P. betle Linn*, such as eugenol and hydroxychavicol, have been reported to exhibit antibacterial activity by inhibiting bacterial growth and biofilm formation. The alkaloids present in *P. betle Linn*, such as piperine and pellitorine, have been reported to exhibit antibacterial activity by disrupting bacterial cell membrane and inhibiting bacterial growth.

- **Antifungal Activity**

P. betle Linn leaf extracts have also been reported to exhibit antifungal activity against various pathogenic fungi, including *Candida albicans*, *Aspergillus niger*, and *Trichophyton mentagrophytes*. The antifungal activity of *P. betle Linn* is attributed to its phenolic and flavonoid content. The phenolic compounds present in PBL, such as eugenol and hydroxychavicol, have been reported to exhibit antifungal activity by inhibiting fungal growth and biofilm formation. The flavonoids present in PBL, such as quinazoline and quercetin, have also been reported to exhibit antifungal activity by disrupting fungal cell membrane and inhibiting fungal growth.

- **Antiviral Activity**

P. betle Linn leaf extracts have been reported to exhibit antiviral activity against various viruses, including herpes simplex virus (HSV), human immunodeficiency virus (HIV), and influenza virus. The antiviral activity of *P. betle Linn* is attributed to its phenolic and flavonoid content. The phenolic compounds present in *P. betle Linn*, such as eugenol and hydroxychavicol, have been reported to exhibit antiviral activity by inhibiting viral replication and entry into host cells. The flavonoids present in

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Pbetle BL, such as quercetin and catechin, have also been reported to exhibit antiviral activity by inhibiting viral replication and entry into host cells.

• Antiparasitic Activity

P. betle Linn leaf extracts have also been reported to exhibit antiparasitic activity against various parasites, including *Plasmodium falciparum*, *Trypanosoma cruzi*, and *Leishmaniadonovani*. The antiparasitic activity of P. betle Linn is attributed to its alkaloid and terpenoid content. The alkaloids present in Pbetle BL, such as piperine and pellitorine, have been reported to exhibit antiparasitic activity by disrupting the parasite cell membrane and inhibiting parasite growth. The terpenoids present in Pbetle BL, such as β -caryophyllene and α -humulene, have also been reported to exhibit antiparasitic activity by disrupting parasite cell membrane and inhibiting parasite growth.

MECHANISM OF ACTION

The antimicrobial activity of P. betle Linn is attributed to the presence of various bioactive compounds, including phenolics, alkaloids, terpenoids, and flavonoids. These compounds have been reported to exhibit antimicrobial activity by disrupting microbial cell membrane, inhibiting microbial growth, and inhibiting biofilm formation. The phenolic compounds present in PbBL, such as eugenol and hydroxychavicol, have been reported to exhibit antimicrobial activity by disrupting microbial cell membrane and inhibiting microbial growth. The alkaloids present in Pbetle BL, such as piperine and pellitorine, have been reported to exhibit antimicrobial activity by disrupting microbial cell membrane and inhibiting microbial growth. The terpenoids present in Pbetle BL, such as β -caryophyllene and α -humulene, have also been reported to exhibit antimicrobial activity by disrupting microbial cell membrane and inhibiting microbial growth.

• Antimicrobial Resistance

Antimicrobial resistance (AMR) is a global public health threat that has led to the emergence of multidrug-resistant (MDR) microorganisms. The development of new antimicrobial agents is crucial to combat AMR and protect public health. P. betle Linn has been proposed as a potential natural antimicrobial agent to combat AMR due to its broad-spectrum antimicrobial activity and low toxicity. However, further studies are needed to evaluate the efficacy and safety of P. betle Linn extracts as a potential antimicrobial agent.

CONCLUSION

P. betle Linn is a well-known medicinal plant used in traditional medicine for various ailments. The leaves of P. betle Linn have been reported to exhibit broad-spectrum antimicrobial activity against various pathogenic microorganisms. The major active compounds responsible for the antimicrobial activity of P. betle Linn are phenolics, alkaloids, terpenoids, and flavonoids. The antimicrobial activity of P. betle Linn is attributed to the disruption of microbial cell membrane, inhibition of microbial growth, and inhibition of biofilm formation. In addition to its antimicrobial activity, P. betle Linn has also been reported to exhibit antiviral and antiparasitic activity.

The antimicrobial activity of P. betle Linn suggests its potential use as a natural antimicrobial agent to combat AMR. However, further studies are needed to evaluate the efficacy and safety of

P. betle Linn extracts as a potential antimicrobial agent. Moreover, the development of standardized protocols for the extraction and characterization of active compounds from Pbetle BL leaves is essential to ensure the reproducibility of results.

In conclusion, the antimicrobial activity of P. betle Linn leaves highlights its potential use as a natural antimicrobial agent. Further studies are needed to evaluate its efficacy and safety, and to develop standardized protocols for the extraction and characterization of active compounds. The use of P. betle Linn leaves in combination with conventional antimicrobial agents may also provide a synergistic effect and reduce the emergence of AMR.

REFERENCES

1. Balakrishnan A, Ganesan P, Singh AB, et al. Antimicrobial activity of Piper betle BetleLinn. *Indian J Pharm Sci.* 2006;68(1):124-126.
2. Singh A, Vats A, Sharma A, et al. Antibacterial and antifungal activity of Piper betle extracts: an in vitro study. *Int J Pharm Sci Res.* 2012;3(8):2623-2628.
3. Kaur R, Sharma S, Kumar S, et al. Antifungal activity of Piper betle Linn. leaves extracts against some dermatophytes. *Int J Pharm Pharm Sci.* 2012;4(2):341-344.
4. Nweze EI. Antibacterial activities of some selected traditional Nigerian medicinal plants. *BMC Complement Altern Med.* 2015;15:1-7.
5. Thangam C, Dhananjayan R. Anti-herpes simplex virus activity of Piper longum leaf extract and piperine. *Res J Med Plant.* 2011;5(2):173-180.
6. Ghosh R, Banerjee A, Kundu A, et al. Eugenol restricts in vitro HSV-1 growth and NF- κ B-dependent expression of proinflammatory molecules by modulating p65 subunit activation. *Mol Cell Biochem.* 2018;437(1-2):23-37.
7. Cheenpracha S, Karalai C, Ponglimanont C, et al. Anti-HIV-1 protease activity of compounds from Boesenbergiapandurata. *Bioorg Med Chem.* 2006;14(6):1710-1714.
8. Kurowska EM, Manthey JA, Casaschi A, et al. Flavonoids from orange juice inhibit proliferation of human breast cancer cells and induce apoptosis. *Nutr Cancer.* 2004;48(1):103-109.
9. Rahman MS, Islam MR, Alam MS, et al. In vitro antiplasmodial activity of some medicinal plants of Bangladesh. *Malar J.* 2011;10:1-6.
10. Rathi MA, Trivedi VJ, Desai KM. Anti-inflammatory and antinociceptive activity of Piper betle Linn. *Indian J Pharm Sci.* 2012;74(3):268-272.
11. Jantan I, Ahmad W, Bukhari SNA. Plant-derived immunomodulators: an insight on their preclinical evaluation and clinical trials. *Front Plant Sci.* 2015;6:1-16.

12. Tsai ML, Lin CC, Lin WC, Yang CH. Antimicrobial, antioxidant, and anti-inflammatory activities of essential oils from five selected herbs. *BiosciBiotechnolBiochem.* 2011;75(10):1977-1983.
13. Singla R, Rana V, Jain A, et al. Effect of Piper betle on dental caries formation and oral microbial count. *J Pharm Bioallied Sci.* 2012;4(Suppl 2):S212-S215.
14. Chitra S, Sajitha GR, Balakrishnan R. Antibacterial activity of crude extracts of Piper betle against dental caries causing bacteria. *Int J Pharm Bio Sci.* 2014;5(4):429-435.
15. Divya M, Raja A, Ramaswamy M. Antibiofilm potential of Piper betle Linn. extract against clinical isolates of *Pseudomonas aeruginosa*. *Biofouling.* 2013;29(5):569-577.
16. Kusumawati I, Arung ET, Kumalasari ID, et al. Piper betle Linn leaf extract enhances the efficiency of doxorubicin in breast cancer cell lines MCF-7 and T47D. *Pharm Biol.* 2016;54(2):227-235.
17. Gohil VM, Patel JA, Gajjar AK. Pharmacological review on natural products with potential to treat hospital-acquired pneumonia. *Drug Res.* 2019;69(1):1-16.
18. Pawar VH, Thaker VS. Preliminary phytochemical and antimicrobial screening of Piper betle L. *Pharmacogn Res.* 2011;3(3):188-192.
19. Sathasivam R, Mohd Ismail NI, Loh YC. In vitro antibacterial activity from Piper betle L. extract. *J Trop Agric Food Sci.* 2013;41(1):39-45.
20. Bharathi A, Latha R, Bhuvaneswari V, et al. Antibacterial activity of Piper betle Linn. leaves against clinical pathogens. *AncSci Life.* 2002;22(1):12-15.