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Natural Approach to Overcome Bacterial Infections: Phytochemicals with Antibiofilm Activity – A Systematic Review

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Structured Abstract

Background: Bacterial infections remain a major global health challenge due to rising antibiotic resistance and the capacity of bacteria to form biofilms. Biofilms are structured microbial communities enclosed in an extracellular polymeric matrix that enhances survival and reduces susceptibility to antibiotics and host immune defenses, leading to chronic and recurrent infections. To address these problems, phytochemicals from medicinal plants have attracted interest as alternative antimicrobial and antibiofilm agents. These natural compounds exhibit diverse bioactive properties and may provide safer and sustainable strategies for infection control. This review evaluates evidence on phytochemicals with antibiofilm activity and examines potential role in bacterial infections.

Methods: A systematic literature search was conducted using major scientific databases including PubMed, Scopus, and Google Scholar. Relevant studies were identified based on predefined inclusion and exclusion criteria. Articles focusing on phytochemicals with demonstrated antibiofilm activity against pathogenic bacteria were selected. Data were extracted on plant sources, types of phytochemicals, bacterial species targeted, experimental methodologies, and reported antibiofilm effects. The selected studies were analysed and synthesized qualitatively to identify common trends and key findings.

Results: The review revealed that several classes of phytochemicals exhibited significant antibiofilm activity, including phenolics, flavonoids, alkaloids, terpenoids, and essential oils. These compounds were reported to inhibit biofilm formation, disrupt established biofilms, and reduce bacterial virulence. The most frequently studied bacterial pathogens included Staphylococcus aureus, Pseudomonas aeruginosa, and Escherichia coli. Proposed mechanisms of action involved interference with quorum sensing, disruption of extracellular polymeric substances, and damage to bacterial cell membranes. Overall, phytochemicals demonstrated promising potential as alternative or complementary agents to conventional antibiotics.

Conclusion: This systematic review highlights the strong potential of phytochemicals as natural antibiofilm agents for the management of bacterial infections. Their broad-spectrum activity and multiple mechanisms of action suggest an important role in combating antibiotic resistance and biofilm-associated infections. Further in vivo investigations and clinical studies are required to confirm their safety, efficacy, and practical application in medical and pharmaceutical fields.

Keywords: Phytochemicals, Antibiofilm Activity, Bacterial Infections, Natural Antimicrobial, Systematic Review.

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