

Comparative Analysis of the Antibacterial Activity of Lemongrass (*Cymbopogon citratus*) Essential Oil and Extract Against Skin Pathogens

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Structured Abstract

Background: Antimicrobial resistance (AMR) remains a serious threat to global public health, particularly for skin and soft tissue infections (SSTIs) caused by opportunistic pathogens such as *Staphylococcus aureus* and *Pseudomonas aeruginosa*. The diminishing effectiveness of conventional antibiotics has intensified the search for safer, sustainable alternatives. Plant-derived antimicrobials like *Cymbopogon citratus* (lemongrass) are recognised for their bioactive compounds, offering a promising option for managing resistant skin pathogens.

Methods: This study assessed the antibacterial potential of ethanolic lemongrass leaf extract and commercial lemongrass essential oil against five skin-related bacterial strains (*S. aureus*, *Bacillus cereus*, *Escherichia coli*, *Klebsiella pneumoniae*, and *P. aeruginosa*). The disc diffusion method was employed to measure the zones of inhibition, while Minimum Inhibitory Concentration (MIC) and Minimum Bactericidal Concentration (MBC) were determined using the broth microdilution assay. Fourier Transform Infrared (FTIR) spectroscopy was also performed to investigate structural changes in bacterial cells.

Results: The disc diffusion assay showed that the essential oil demonstrated clear antibacterial activity against Gram-positive strains, with *S. aureus* and *B. cereus* displaying the largest inhibition zones at 100% concentration (15.00 ± 1.00 mm). Gram-negative strains exhibited smaller or absent zones, indicating higher intrinsic resistance. MIC and MBC results confirmed strong bactericidal activity of the essential oil for *S. aureus* and *B. cereus*, with bacteriostatic effects observed for Gram-negative bacteria. Statistical analysis validated the significance of these findings. Meanwhile, the crude ethanolic extract showed subtle antibacterial interaction through FTIR spectral shifts, despite lacking measurable inhibition zones or MIC/MBC values.

Conclusion: This study demonstrates that lemongrass essential oil has promising antibacterial potential against Gram-positive skin pathogens, particularly *S. aureus* and *B. cereus*, and could serve as a natural alternative for managing SSTIs associated with AMR. Although the crude extract exhibited limited direct inhibition, its spectral profile indicates possible molecular interactions, highlighting the need for further extraction optimisation to improve its potency. These findings support future research and product development to integrate lemongrass-based antimicrobials into modern dermatological applications.

Keywords: *Cymbopogon citratus*, Lemongrass Essential Oil, Lemongrass Extract, Gram-positive Bacteria, SSTIs

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