

Antibacterial Activity of Eugenol Derivatives Against *Streptococcus Mutans*

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Eugenol is the major constituent of clove essential oil and act as an antibacterial agent commonly used in dentistry in the form of Zinc Oxide-Eugenol (ZOE) to inhibit oral bacteria, specifically *Streptococcus mutans* which is the main contributor to dental caries. However, due to the high virulence of *S. mutans*, higher concentrations of eugenol are required for effective bacterial inhibition, reducing its efficacy as an antibacterial agent against this bacterium. To address this challenge, this study aimed to enhance the antibacterial activity of eugenol through functional group modifications. Additionally, this study focuses on investigating the structure - activity relationship of eugenol on antibacterial activity against this bacterium. Eugenol was extracted via steam distillation of clove buds followed by solvent extraction. Six derivatives were synthesized through acylation and esterification reactions at the hydroxyl group, as well as by epoxidation of the double bond. All compounds were characterized by FTIR spectroscopy, while the epoxy derivative was further characterized by NMR spectroscopy. The antibacterial activity of eugenol, clove oil, and the synthesized derivatives were evaluated using the disc diffusion method. To date, these derivatives have not been evaluated against *S. mutans*. According to the results, only eugenol, clove oil, and the epoxy derivative exhibited inhibitory activity against *S. mutans*. Notably, the epoxy derivative synthesized via an addition reaction demonstrated mild inhibitory activity. In contrast, the derivatives obtained through alkylation and esterification reactions were inactive. These findings suggest that only compounds possessing a free hydroxyl group were effective against *S. mutans*, indicating that the presence of a free hydroxyl group is essential for antibacterial activity against *S. mutans*. Future studies can focus on designing eugenol derivatives with enhanced antibacterial properties while preserving at least one free hydroxyl group to retain activity.

Keywords: Antibacterial activity, clove, eugenol, eugenol derivatives, *S. mutans*