

# Antimicrobial and Biofilm Inhibition Properties of Novel Bio-based Quaternary Ammonium Salts

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The rise of antibiotic-resistant microorganisms continues to pose a serious global health threat, highlighting the urgent need for new agents with both antimicrobial and antibiofilm properties. Quaternary ammonium salts (QASs), widely used as disinfectants, represent a promising class of such compounds. In this study, we present a sustainable approach to synthesizing QASs, namely quaternary esters, hydroxyamides, and dihydroxyamides, with C12–C18 alkyl chains. These compounds were prepared in a three-step synthesis from fatty acid methyl esters, which can be derived from used cooking oil, offering a potential route for valorizing this waste material. The antimicrobial activity of the synthesized QASs was evaluated against *Staphylococcus aureus*, *Escherichia coli*, *Pseudomonas aeruginosa*, *Candida albicans*, and *Aspergillus brasiliensis*, with biofilm inhibition activity tested against the bacterial strains. The results were compared with those of benzyldimethyldodecylammonium chloride (BDMDAC), a common disinfectant. Compounds based on myristic and palmitic acids demonstrated strong antimicrobial and biofilm inhibition activity, in some cases surpassing BDMDAC. Notably, stearic acid quaternary hydroxyamide and dihydroxyamide achieved maximum biofilm inhibition activity at the lowest concentration tested—0.016 mmol L<sup>-1</sup>. This study highlights a promising strategy for transforming waste fats into effective bioactive agents, with potential applications in next-generation disinfectants targeting biofilms.

