Novel Alkyl Quaternary Phosphonium Compounds (Alkyl QPCs) as Antimicrobial Agents

University Investigators

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Background and Unmet Need

For nearly 100 years, quaternary ammonium compounds (QACs) have been the standard antimicrobial agents in the disinfectant market. Within this class of disinfectants, Benzalkonium Chloride (BAC) is the most commercially visible product. After decades of dependence on QACs, the emergence of antimicrobial-resistant strains of bacteria such as *A. baumannii* and *P. aeruginosa* poses a significant health threat, most notably in hospital settings.

During the COVID-19 pandemic, the use of antimicrobial materials, including QACs, rose to unprecedented levels, and usage remains elevated. With a drastic increase in the usage of QAC-based cleaning supplies, there is heightened concern about an accelerated spread of QAC resistance.

The creation of novel antimicrobial structures, such as quaternary phosphonium compounds (QPC), is of crucial importance for human health. They respond to the urgent need for a new class of promising antimicrobials that boast significant activity against highly resistant bacteria.

Opportunity

The current global disinfectant market is forecasted to have a value of more than $14.9 Bn by 2030.[1] QACs hold the highest share of active disinfectant agents on the market, despite their contribution to increased antimicrobial resistance. This invention will contribute to that market as an alternative to QACs to mitigate the transfer of pathogenic bacteria that have developed resistance.

Villanova University scientist Dr. Kevin Minbiole, in collaboration with Dr. William Wuest of Emory University, has developed novel alkyl biscationic quaternary phosphonium compounds (alkyl bisQPCs), which stand to disrupt the disinfectant market currently dominated by QACs.

In determining the bioperformance of novel alkyl bisQPCs, investigators tested these compounds against a broad spectrum of Gram-positive and Gram-negative bacteria strains, including those known to have antimicrobial resistance. These novel QPCs

[1] *Global Disinfectants Market, 2020 – 2030*, Transparency Market Research, May 4, 2022.

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proved to be highly effective against Gram-positive and Gram-negative pathogenic bacterial strains.

Further, the top three performing alkyl bisQPC compounds tested all significantly outperformed control compounds (2- to 64-fold improvements), which include commercially available BAC. Such performance confirms the viability of alkyl bisQPC as a competitive and effective antibacterial product.

Unique Attributes

- Effective at biofilm eradication, including MRSA strains
- Broad-spectrum antimicrobial performance against Gram-positive and Gram-negative bacteria strains, including those with antimicrobial resistance.
- Simple and high-yielding one-step product syntheses
- Atom-economical phosphorus-based compounds

Applications

This invention can be commercialized as a variety of disinfectant products for multiple industries, such as home-cleaning products, industrial / commercial settings, and hospital settings. Products made from this compound include but are not limited to:

- Anti-microbial gels/liquids
- Anti-microbial surface cleaner wipes
- Anti-microbial sprays

Stage of Development

Prototype and Proof of Concept.

Intellectual Property

PCT Application Filed November 2023.

Licensing and Collaboration Opportunity

Villanova is seeking a licensee or collaborators to commercialize the invention. Also, please see companion intellectual property: “Novel Quaternary Phosphonium Compound (QPC) Disinfectants” and “Novel Soft Quaternary Phosphonium Compound (Soft QPC) Collection as Antimicrobial Agents.”

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