PROTECTION - SCIENCE AND TECHNOLOGY ADVANCES FOR CHEMICAL AND BIOLOGICAL PROTECTION

Investigating Surface Binding Effects: Antibacterial Efficacy Of Bound 8-hydroxyquinoline Against Staphylococcus Aureus And Escherichia Coli

Shelle McDonald Arctos **Bruce Salter** Arctos **Molly Richards** Natick Army CCDC **Jeff Owens** AFCEC/CXAE

Recent changes in regulations due to environmental concerns prompted many companies and organizations to explore antimicrobial treatments that are chemically bound to the product. Chemically bonding biocidal compounds to a surface limits environmental release; however, molecular mechanisms that drive antibacterial activity when compounds are immobilized are limited. In an effort to investigate the binding of the antimicrobial compound 8-hydroxyquinoline (8HQ) to a material interface and determine whether immobilization affects the antibacterial efficacy, the 8HQ derivative 5-carboxy-8-hydroxyquinoline (5C8HQ) was attached to silica beads through amide bond coupling at the carboxyl moiety of 5C8HQ. Attachment of 5C8HQ was confirmed using a combination of mass spectrometry, thermogravimetric analysis, colorimetric testing, and Soxhlet extraction. Computational modeling results indicated that this substitution did not compromise the active sites on the molecule, whereas other positions on the ring system could potentially inhibit antimicrobial activity. The antibacterial effect of 8HQ and the 5C8HQ-modified silica complex against Escherichia coli 15597 (ATCC® 25922) and Staphylococcus aureus (ATCC® 25923) were evaluated. Test results showed that the immobilized 8HQ continues to exhibit antibacterial activity, however, quantifying the efficacy compared to free 8HQ bears further investigation. The expected antibacterial mechanism requires that the metal chelation site of 8HQ be retained and available after attachment to a surface. The retention of antibacterial activity after surface bonding represents a novel mechanism of action not previously reported. The results reported here demonstrate that the 8HQ reactive site retains antibacterial efficacy even after covalent attachment to a surface. This approach supersedes other antimicrobial treatments where the active component is gradually released from the material surface in order to elicit antimicrobial effects. This specific antibacterial activity of bound 8HQ represents a novel mechanism of action not previously reported, and a potential conduit to a new class of bound antimicrobial materials.

Journal of Applied Microbiology, Volume 131, Issue 5, November 2021, Pages 2212-2222