MODIFICATION OF POLYMERIC MATERIALS WITH ANTIMICROBIAL CYCLODECAPEPTIDES TO CREATE STERILISING MATERIALS

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ABSTRACT

Agriculture and many other industries experience great losses due to persistent bacterial and fungal infections which can be attributed to antibiotic or biocide resistance caused by the formation of biofilms. Prevention of microorganism colonization to the surface can be done by covalent coupling, coating or absorption of antimicrobial agents to solid surfaces. Cyclic antimicrobial peptides (AMPs) such as gramicidin S and tyrocidines exhibit a broad spectrum activity against bacteria and fungi, but also have limited potential to elicit resistance due to their rapid membranolytic activities. These peptides also have an inherent bio-stability and tend to adhere tightly to surfaces, making them ideal candidates for the development of antimicrobial surfaces.

Gramicidin S and a tyrocidine extract were used to treat eight polymer matrices: filters containing mixed nitrocellulose and cellulose acetate, polivinylidene difluoride, polycarbonate, cellulose acetate, cellulose (paper) and high density cellulose packing material. The integrity and presence of the peptides on selected matrices were confirmed by means of induced desorption and subsequent mass spectroscopy analysis. It was determined, utilising scanning electron microscopy, that the peptides adsorbed do not affect the structural integrity of the treated filters. However, we found with a wettability assay that the absorbed peptides did change the hydrophobic/hydrophilic character of some of the filters in our study.

A cell viability assay, developed from existing methodologies, was used to show that seven of the AMP treated solid surfaces had antimicrobial activity when challenged with $>10^5$ *Micrococcus luteus* cells/cm^2. Antimicrobial activity was also observed for the peptide treated cellulose filters against the biofilm-forming food pathogen *Listeria monocytogenes.* Stability tests showed that the tyrocidines remained adsorbed to cellulose filters and biologically active when exposed to a range of solvents, water washes at different temperatures (25°C -100°C) and pH changes (pH 1-12).

Based on the potent antimicrobial activity and stability of the cyclodecapeptide functionalised polymeric matrices it can be concluded that these materials have the potential to prevent bacterial colonization and biofilm formation. Moreover it can be developed and tailored to a specific application such as filters, towels, catheters and packaging materials.