SUBMISSION

Genetically engineered protein-based polymers with broad antimicrobial activity for biomedical applications

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Abstract

With increasing healthcare-associated infections and antibiotic-resistant microorganisms there is a demand not only for new antimicrobial compounds but also for antimicrobial materials. With the use of synthetic protein biotechnology approaches and recombinant DNA technology, we can now create new tailor-made materials with precise control over its sequence. Indeed, by combining antimicrobial activity of naturally occurring antimicrobial peptides (AMPs) with recombinant protein-based polymers, such as elastin-like recombinamers (ELRs), it is possible to create novel materials that can be explored for the development of advanced antimicrobial medical devices. In the present work, we have functionalized an ELR with AMPs for the development of biopolymers with antimicrobial activity. The antimicrobial ELRs were designed by cloning the DNA sequence coding for different AMPs in frame with the N-terminus of an ELR consisting of 200 repetitions of the pentamer VPAVG (A200). The new functionalized recombinant biopolymers were purified via a simplified non-chromatographic method, making use of the thermoresponsive behaviour of A200. These were further processed into different materials namely, particles by self-assembling, fibres by electrospinning and free-standing films by solvent casting. The produced materials demonstrated to be highly effective against different microorganisms including Gram-positive and Gram-negative bacteria, yeasts and filamentous fungi. Further, the antimicrobial performance showed to be time-dependent and mediated by direct contact with cells, suggesting a mechanism of irreversible cell damage and disruption. Moreover, the antimicrobial materials demonstrated to be non-cytotoxic to both normal human skin fibroblasts and human keratinocytes. Finally, we have developed an optimized *ex vivo* assay with pig skin for testing the antimicrobial activity of film-type materials targeted for skin applications.

Datasets

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