Invited Editorial

Recent Developments in Antimicrobial Peptide and Bacterial Biofilm Research

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Each year, 25,000 people die in Europe as a result of antibiotic-resistant infections, costing the European Union >1.5 billion euros [1]. A similar scenario takes place in the United States, where >2 million people are infected with drug-resistant bacteria leading to 23,000 deaths annually [1]. In addition to the increase in bacterial resistance to available antibiotics, no antimicrobials designed to combat these recalcitrant infections have been approved for use in humans [2].

However, in recent years increasing effort has been devoted to identifying strategies against persistent infections. One such approach is the use of antimicrobial peptides (AMPs) as templates to generate synthetic peptide variants with improved activity. AMPs are evolutionarily conserved, naturally occurring molecules produced by all living organisms as a defense mechanism against infections. These peptides are small in size (12 - 50 amino acids) and are cationic as a result of containing excess lysine and arginine amino acid residues [3]. AMPs typically have ~50 % of hydrophobic residues to enable their interaction with membranes, and translocation into bacterial and host cells, which is key to their diverse biological activities [3].

Another field that has attracted the interest of numerous researchers worldwide is the study of biofilms, which are multicellular consortia of bacteria that are responsible for at least two thirds of all infections in humans and are highly adaptively resistant to conventional antibiotics [4-7].

These two fields have recently converged, encouraged after the initial observation was made that the AMP human cathelicidin LL-37 was capable of inhibiting biofilm formation in the Gram-negative bacterium *Pseudomonas aeruginosa* [8]. Since then a number of studies have focused on optimizing the amino acid sequence of LL-37 and other AMPs (e.g., indolicidin, bactenecin, etc.) to potentiate their anti-biofilm properties [9-14], and some of the most potent peptides have been proven to work in animal models [14].

The alarming rise in antibiotic resistance combined with the lack of new antimicrobials entering the clinic or under development in the antibiotic pipeline has caused the White House [15] and the World Health Organization (WHO) [16] to propose specific action plans to combat antibiotic resistance.

In this Special Issue on Biofilms and Antimicrobial Peptides, we have aimed to provide an overview on new exciting discoveries related to AMPs, in particular their potential as biofilm inhibitory agents, and have reviewed the very significant role biofilms play in clinically difficult-to-treat infections. García-Gonzalo and Pagán describe the pronounced influence of the environment in biofilm development in the context of the food industry (doi.org/5g4). Agbale et al. discuss procedures to optimize the biological activity of AMPs, for example to obtain peptides with enhanced activity against bacterial pathogens while preserving low toxicity towards mammalian cells (doi.org/5g5). Reffuveille reviews the promise of antibiofilm agents derived from AMPs both in clinical and industrial settings (doi.org/5g6). van Tilburg Bernardes et al. highlight different approaches to target biofilms, including the use of AMPs, polymers and bacteriophages (doi.org/5g7).

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