Antibacterial Activity of Specialized Biomolecules

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Abstract

The increased resistance of bacteria against conventional pharmaceutical solutions, the antibiotics, has raised serious health concerns. This has stimulated interest in the development of bio-based therapeutics with limited resistance, namely, essential oils (EOs) or antimicrobial peptides (AMPs). This study envisaged the evaluation of the antimicrobial efficacy of selected biomolecules, namely LL37, pexiganan, tea tree oil (TTO), cinnamon leaf oil (CLO) and niaouli oil (NO), against four bacteria commonly associated to nosocomial infections: *Staphylococcus aureus*, *Staphylococcus epidermidis*, *Escherichia coli* and *Pseudomonas aeruginosa*. The antibiotic vancomycin and silver nanoparticles (AgNPs) were used as control compounds for comparison purposes. The biomolecules were initially screened for their antibacterial efficacy using the agar-diffusion test, followed by the determination of minimal inhibitory concentrations (MICs), kill-time kinetics and the evaluation of the cell morphology upon 24 h exposure. All agents were effective against the selected bacteria. Interestingly, the AgNPs required a higher concentration (4000–1250 µg/mL) to induce the same effects as the AMPs (500–7.8 µg/mL). Pexiganan was the most effective biomolecule, requiring lower concentrations to kill both Gram-positive and Gram-negative bacteria (62.5-7.8 µg/mL), within a short period of time (averaging 2 h 15 min for all bacteria). Most biomolecules apparently disrupted the bacteria membrane stability due to the observed cell morphology deformation and by effecting on the intracellular space. AMPs were observed to induce morphological deformations and cellular content release, while EOs were seen to split and completely envelope bacteria. Data unraveled more of the potential of these new biomolecules as replacements for the conventional antibiotics and allowed us to take a step forward in the understanding of their mechanisms of action against infection-related bacteria.

Keywords: antimicrobial peptides; essential oils; minimum inhibitory concentration; bactericidal; nosocomial