20.3 New Findings for the Treatment of Pathogenic Biofilms

Although combined antibiotic therapy is a promising strategy for replacing the use of antibiotics alone against pathogenic biofilms, new treatment options are required due to the biofilm resistance multifactorial nature to antibiotics available on the market. In this regard, antimicrobial peptides (AMPs) (natural or synthetic), bacteriophages, and nanotechnology have been increasingly recognized as promising strategies for the development of unusual anti-biofilm treatments (Grassi et al. 2017).

20.3.1 AMPs Applied to Treatment Pathogenic Biofilms

AMPs comprise a heterogeneous group of evolutionarily conserved molecules, which consist of important natural effectors of the innate immune system of uni/multicellular organisms (Mookherjee and Hancock 2007; Moreno et al. 2017). Structurally, AMPs can be differentiated into four main classes: α-helical, β-sheet, extended, and mixed, with the first two classes being the most recurrent in nature (Chung and Khanum 2017).

The AMPs with anti-biofilm activity, as well as the AMPs that fight against microorganisms in the planktonic state, are small in size (12–50 amino acid residues, with 2–9 basic residues of arginine and lysine) and are cationic and amphipathic (Fuente-Núñez et al. 2014a; Sharma et al. 2016).

AMPs have been proposed as potential anti-biofilm agents because they present a broad spectrum of biological activity and low specificity of their molecular target (López-Meza et al. 2015; Batoni et al. 2016b), present high potential to reach metabolically inactive cells, and have a low propensity to induce resistance mechanisms, characteristics that make them strong candidates for pharmacological applications (Grassi et al. 2017).

In the perspective of AMPs with anti-biofilm activity, Di Luca and co-workers(2015) developed a database called *BaAMPs, Biofilm-active AMPs* database (http://www.baamps.it), which aims to make available the peptide sequences and experimental data of AMPs specifically tested against biofilms. This database aims to provide the scientific community with an open-access platform for consultation and for assistance in the development of AMPs aimed at this activity (Di Luca et al. 2015).

AMPs have been isolated from numerous organisms, such as single-celled microorganisms, plants, invertebrates, and chordates (Mookherjee and Hancock 2007). Among the most well-characterized AMPs with anti-biofilm activity, we can highlight magainin II, α-helical AMP originally isolated from the skin of the African toad *Xenopus laevis* (Kim et al. 2018); cathelicidin LL-37, α-helical AMP of human origin (Jacobsen and Jenssen 2012); and defensin-1, peptide produced by bees and by them added to honey (Sojka et al. 2016).