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Zakład Mikrobiologii Lekarskiej i Inżynierii Nanobiomedycznej

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Evaluation of the Potential Application of Ceragenins in the Treatment of Bacterial and Fungal Infections of the Oral Cavity: An In Vitro Study

Rozprawa doktorska na stopień doktora nauk medycznych
w dziedzinie nauk medycznych i nauk o zdrowiu, dyscyplinie nauki medyczne

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8. STRESZCZENIE W JĘZYKU ANGIELSKIM

Oral infections constitute a significant health problem, affecting overall well-being. Natural antimicrobial peptides (AMPs) play a crucial role in defending the body against oral infections but their clinical application is limited due to their high sensitivity to proteolytic enzymes. Ceragenins are synthetic, lipid derivatives of AMPs, mimicking their mechanism of action and exhibiting a broad spectrum of antimicrobial activity against bacteria, fungi, and viruses, as well as the ability to inhibit biofilm formation and modify the mechanical properties of bacteria. Due to their anti-inflammatory, regenerative, and immunomodulatory effects, ceragenins represent a promising option for treating oral infections.

This study aimed to evaluate the antimicrobial and anti-biofilm activity of selected ceragenins (CSA-13, CSA-44, CSA-131, CSA-255) against bacterial and fungal strains associated with oral infections and compare their activity to other antimicrobial peptides and commercial oral hygiene products. The study was conducted using aerobic bacterial strains (*E. faecalis, E. hirae, S. mutans*), anaerobic bacteria (*B. fragilis, Prevotella, Capnocytophaga*), and fungi (*Candida*). The therapeutic potential of the tested compounds was assessed by determining the minimum inhibitory concentration (MIC) and the minimum bactericidal/fungicidal concentration (MBC/MFC). Formation of fungal and bacterial biofilms as well as mixed, dual-species biofilms were assessed by fluorimetry. The biocompatibility of ceragenins was assessed in cell culture models using the HGF-1 (ATCC® CRL-2014™) human gingival fibroblast cell line and human erythrocytes isolated from the blood of healthy donors using colorimetric and microscopic analyses.

Studies have shown that ceragenins, especially ceragenin CSA-13 and CSA-131, have strong antimicrobial activity against bacteria and fungi, which are representatives of the oral microflora, and their efficacy exceeds that of LL-37 and omiganan peptides. Ceragenins also showed high efficacy in inhibiting bacterial and fungal biofilm formation, especially against

E. faecalis, S. mutans, and *Candida* spp. strains, and the observed activity is comparable to the effect obtained for commercial oral hygiene products. Additionally, ceragenins presented a low ability to induce hemolysis (<4%) of red blood cells and high biocompatibility with human HGF-1 (ATCC® CRL-2014™) gingival fibroblasts, demonstrating potential safety in future clinical applications. The study suggests that ceragenins may be effective antimicrobial compounds and ingredients for daily oral hygiene formulations, as well as for the treatment of inflammation and post-surgical conditions in dentistry, including in oncology patients.

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