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Abstract

Antimicrobial Activity of a Bacterial Nanocellulose Film Functionalized with Nisin Z for Prospective Burn Wounds Treatment †

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Abstract: Burn wounds can lead to numerous severe complications including bacterial infections causing patient morbidity and mortality, mostly in low- and middle-income countries. The considerable increase in microbial resistance against traditional antibiotics is leading towards alternative strategies to treat bacterial infections. Nisin Z is an antimicrobial peptide which exhibits a significant antibacterial activity against Gram-positive bacteria. Its efficacy against Gram-negative bacteria is limited, nonetheless it can be improved with the addition of surfactants, such as ethylenediaminetetraacetic acid (EDTA). The incorporation of peptide and other biomolecules within a biopolymer matrix provides protection maintaining their antimicrobial potential. Bacterial nanocellulose (BNC) has been widely used as wound dressings. Its impressive water retention capacity (>99%) and porosity are beneficial to manage wounds due to its potential to absorb exudates, providing a breathable and humid environment. In this work, the functionalization of BNC with Nisin Z (BNC-NZ) via vacuum filtration is reported. The entrapment of the peptide inside the BNC films was confirmed through morphological characterization using attenuated total reflectance-Fourier transform infrared (ATR-FTIR) spectrometry. Typical absorbance peaks of Nisin Z are easily identifiable at 1647 cm^{-1} (amide group) and 1520 cm^{-1} (bending of primary amines). Thermal gravimetric analysis (TGA) suggested that Nisin Z did not interfere with the BNC matrix. The antimicrobial activity of Nisin Z against five of the most common bacteria found in burn wounds was verified by minimum bactericidal concentration (MBC) ranging 8.0–256.0 µg/mL. Agar diffusion and shake flask methods revealed the potential of BNC-NZ for prospective applications in burn wound dressings.

Keywords: antimicrobial peptides; Nisin Z; bacterial nanocellulose; wound dressing

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