Enhanced Antibacterial and Biocompatible Bacterial Cellulose-Aloe Praetermissa Latex Hydrogels for Advanced Wound Healing Applications

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ABSTRACT

Bacterial cellulose (BC) hydrogels have garnered significant attention in biomedical research due to their exceptional water retention, biocompatibility, and tunable antibacterial properties, making them ideal candidates for wound dressing applications. In this study, a novel BC-based composite hydrogel (BC-AL) was developed by incorporating Aloe praetermissa latex into the BC matrix. The resulting hydrogels exhibited enhanced antibacterial properties, demonstrating a 1.6 mm zone of inhibition against both Gram-positive (S. aureus) and Gram-negative (E. coli) bacteria in disc diffusion assays. Additionally, bacterial viability assays revealed a significant reduction in bacterial counts, with a 85 % decrease observed through plate count methods. Compared to pure BC hydrogels and the negative control, the BC-AL composites exhibited superior antibacterial activity, improved wound closure rates, and enhanced cellular proliferation in vitro wound healing assays. The combination of BC's structural integrity with the bioactive and antimicrobial properties of Aloe praetermissa latex suggests an improved capacity to accelerate wound healing, reduce infection risks, and support tissue regeneration. These findings position BC-AL hydrogels as promising candidates for next-generation wound dressings, offering an effective solution for chronic and acute wound management.

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