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Living-Bacterial Hydrogels: A Promising Frontier in Accelerated Wound Healing

ABSTRACT

Living-bacterial hydrogels (LBHs) are a class of smart biomaterials that incorporate beneficial bacteria within a biocompatible hydrogel matrix to enhance wound healing. These hydrogels support cell attachment, proliferation, and migration while actively promoting tissue regeneration through the secretion of growth factors such as vascular endothelial growth factor (VEGF) and transforming growth factor-beta (TGF-β). For my research, I conducted a literature review of 30 primary sources to investigate how LBHs influence the wound healing process, their therapeutic potential, and the biological mechanisms involved. This review also examined how LBHs modulate the immune response by promoting anti-inflammatory cytokines and suppressing pro-inflammatory ones, creating a balanced environment conducive to healing. Commonly used probiotic bacteria, such as *Lactobacillus* and *Bifidobacterium* species, can be naturally selected or genetically engineered for optimal therapeutic effects. While LBHs show promise for treating chronic wounds, diabetic ulcers, and surgical wounds, they also pose risks, including potential infections, immune sensitivities, and raise concerns surrounding the use of genetically modified organisms. Despite these challenges, LBHs represent an innovative and effective approach to improving wound care outcomes, with ongoing research focused on enhancing their safety, efficacy, and accessibility.