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Biodegradable and injectable poly (vinyl alcohol) microspheres in silk sericin-based hydrogel for the controlled-release of antimicrobials: Application to deep full-thickness burn wound healing

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Deep full-thickness burn wounds are prone to multi-drug resistant (MDR) infections following injury, which extends the healing time. Thus, providing a bioactive hydrogel dressing with prolonged antimicrobial activity and reduced dressing changes is quite desirable for accelerating burn wound healing and preventing scarring. To achieve this, we developed an injectable hydrogel based on silk sericin (SS), poly (vinyl alcohol) (PVA) and PVA microspheres (MSs) containing vancomycin (VA), gentamicin (GEN), or their association (VG) for the healing of infected burn wounds. The microspheres were prepared by inverse emulsion crosslinking, while the hydrogels were prepared by freeze-thawing cycles. Antibacterial studies showed that gentamicin acts synergistically with vancomycin by increasing the bacterial killing rate and enhancing the biofilm inhibition and eradication effects on methicillin-resistant *Staphylococcus aureus* more than on *Pseudomonas aeruginosa* and *Escherichia coli*. Findings from SEM images showed that the microspheres were sphere-shaped with a smooth surface and their average diameter ranging from 26.22 to 32.42 µm suitable for parenteral drug delivery. The prepared hydrogel containing 10% of microspheres was more elastic than viscous, with lower than delta values (<1) suited for deeper injection with homogeneous tissue integration. The incorporation of VG-PVAMS in the PVA/SS hydrogel led to zero-order release kinetics and efficient antimicrobial effects. Moreover, the *in vivo* study using a rat full-thickness burn model showed that the VG-PVAMS@PVA/SS hydrogel displays a better therapeutic effect than drug-free PVAMS@PVA/SS hydrogel and TegadermTM film dressing by inducing early vascularization and collagen deposition, leading to early re-epithelialization and burn wound closure.

Recent Publications

1. Bakadia, B.M., Zhong, A., Li, X. et al. Biodegradable and injectable poly (vinyl alcohol) microspheres in silk sericin-based hydrogel for the controlled release of antimicrobials: application to deep full-thickness burn wound healing. Adv Compos Hybrid Mater 5, 2847–2872 (2022).

2. Bakadia, B.M. et al. (2022). Microbiome as Cancer Biomarkers. In: Shehzad, A. (eds) Cancer Biomarkers in Diagnosis and Therapeutics. Springer, Singapore.

Biography

Bianza Moise Bakadia is currently a Ph.D. student at Huazhong University of Science and Technology and a research fellow at the Higher Institute of Medical Techniques of Lubumbashi, DR. Congo. He received a Bachelor of Science degree from the Higher Institute of Medical Techniques of Lubumbashi, DR. Congo and a Master's degree from Huazhong University of Science and Technology, China. His research interests include biomedical analysis of biological fluids, the immune response to microorganisms and the development of biomaterials for tissue engineering. He has published more than 19 SCI papers.

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