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Agarose-based immunomodulatory and antibacterial nanofibrous mats for addressing chronic cutaneous wounds

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Any disintegrity or rupture of skin architecture leads to a wound, and its repairing process is termed wound healing. Diabetic foot ulcers and chronic wounds take longer to heal than acute wounds due to a disturbed healing cascade leading to prolonged inflammation. The prolonged inflammatory phase results in a large amount of exudate within chronic wounds (fungating wounds, venous leg ulcers, pressure ulcers, burns) and diabetic foot ulcers leading to delayed healing. Approximately 6% of the world population develops chronic wounds, and 37 million suffer morbidity and mortality from these wounds during their lifetime.

As a result, the global wound care market is expected to be 27.8 billion USD by 2026 from 19.3 billion USD in 2021, at a compound annual growth rate (CAGR) of 7.6% during the forecast period. Several biomaterials, including wound dressings, have been used since the rise of Egyptian civilization to treat wounds. However, natural polymer-based nanofibrous wound dressings have gained increased attention because of their high surface area, bioactivity, biodegradability, and resemblance to the extracellular matrix. Agarose and curdlan natural polymers have been used for angiogenesis, cartilage formation, immunomodulation, and wound healing applications. Thus, the present research focuses on fabricating and evaluating agarose-based multifunctional nanofibrous scaffolds.

During these studies, curdlan (an immunomodulator) was blended with agarose to combat inflammation by modulating the expression of pro-inflammatory and anti-inflammatory cytokines. In preliminary results, the fabricated scaffolds exhibited ~550% swelling (in phosphate buffer saline) with enhanced mechanical strength, which is suitable for most wound healing applications.

In vitro studies revealed an increased migration and proliferation of L929 mouse fibroblasts with agarose blends w.r.t to the control. Moreover, the fabricated dressings were effective against Escherichia coli (Gram-negative) and Staphylococcus aureus (Gram-positive) bacterial strains.

Keywords: Antibacterial immunomodulatory dressings, benign solvent, nanofibrous Agarose, biocompatibility, enhanced swelling and mechanical strength, biopolymeric dressings

Recent Publications

1. Latiyan S, Kumar TSS, Doble M. Fabrication and evaluation of multifunctional agarose based electrospun scaffolds for cutaneous wound repairs. Journal of Tissue Engineering and Regenerative Medicine. 2022 Jul;16(7):653-664.

Biography

Sachin Latiyan is an exuberant researcher, holds interdisciplinary research experience in areas like Microfabrication (Photolithography), Biomaterials (Electrospinning, electrospray & freeze drying), Nanomaterials (synthesis and characterization), Polymers and Composites (GO-Magnetite), and Corrosion Engineering (Cathodic Protection and Pipeline Corrosion)

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