Abstract

STUDIES ON THE DEVELOPMENT OF DEXTRAN BASED BIONANOCOMPOSITE MEMBRANES FOR WOUND CARE

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Wound repair is a complex process involving systemic and balanced functioning of inflammatory, connective, vascular tissue and epithelial cells. Effective management of wound infection requires prolonged prevention from microbial contamination along with accelerated wound healing and aesthetic closure of the wound. With these objectives in mind, an effort has been directed towards the development of herbal based bionanocomposite membranes for wound care in the current study.

This investigation is associated with the preparation of soy protein isolate nanoparticles (nanosoy) reinforced dextran based wound dressings, which are the nanocomposites based on naturally derived plant protein and a polysaccharide. Nanosoy (NS) was prepared by nanoprecipitation which enabled excellent control over protein aggregation, producing nanoparticles in the size range of 5-15 nm. The effect of various process parameters, such as the temperature, solvent/nonsolvent ratio, crosslinker content and type of surfactant on the particle size of nanosoy has been investigated.

Crosslinked nanocomposite membranes were then developed by in-situ reaction of dextran and nanosoy. The formation of covalent bond between the reducing end of dextran and amine groups of NS leads to the in-situ crosslinking. Glycerol addition assisted in the plasticization of membranes, thus improving their flexibility and handling features. The effect of polymer composition, polymer concentration and glycerol content on the extent of crosslinking, morphology and flexibility of the obtained dextran/nanosoy/glycerol (DNG) membranes has been investigated.

In the next step of the study, chitosan incorporation into DNG membranes was carried out to develop dextran/nanosoy/glycerol/chitosan (DNG/Ch) membranes. The membranes were characterized for their structural, mechanical and biological behavior. Further, to fabricate dextran based bionanocomposite wound dressings, bioactive agents were incorporated into DNG/Ch membranes. Wound care membranes were produced by casting the mixed solutions of biopolymers in water at 70°C followed by subsequent addition of clove oil (CO), sandalwood oil (SO), aloe vera (AV) and manuka honey (MH) at room temperature to obtain DNG/Ch/CO, DNG/Ch/SO, DNG/Ch/AV and DNG/Ch/MH wound dressings. The antibacterial behavior of the dressings was studied against both S. aureus and E. coli at different drug concentrations. Drug release was measured over a period of 72 h for drug loaded dressings and bacterial adherence test was performed on them to demonstrate their efficiency for arresting microbial invasion.

Lastly, in vivo wound healing studies and histological examination was conducted using male swiss albino mice of Balb/C strain. DNG/Ch/AV dressings exhibited complete healing in just 14 days with remarkable efficacy in prevention of scar formation. Histological analysis on healed tissue revealed the deposition of ordered collagen along with fibroblast migration in drug loaded membranes as compared to DNG and DNG/Ch dressings.