DEVELOPMENT OF ALGINATE BASED ANTIMICROBIAL HEMOSTATIC DRESSINGS

Abstract

Excessive blood loss is known as primary cause of civilian and war field deaths and is also known for the debilitation of wound healing process. Irrepressible bleeding is also an inevitable reason for microbial infection. These challenges necessitate the development of materials with multifunctional properties of immediate blood clotting. Thus, present work was undertaken to develop herbal incorporated alginate based antimicrobial hemostatic cotton dressings for immediate blood clotting and antimicrobial activity.

First section of the thesis deals with the size controlled synthesis of nano silver encapsulated carboxymethyl cellulose gels (CMC-Ag nanogels) to impart infection resistant activity to the cotton fabric. The morphological analysis of CMC-Ag nanogels was investigated through HR-TEM analysis which indicated the core shell structure formation in the size range of 5-10 nm. Encapsulation of nano silver inside CMC matrix provided the functional groups to CMC-Ag nanogels for adhering on the cotton fabric. Optimized CMC-Ag nanogels with varying concentrations of silver nitrate were immobilized on the cotton fabric and investigated for their antimicrobial activity against *E. coli* (Gram-negative) and *S. aureus* (Gram-positive) bacterial strains. The fabric with >99% bacterial colony reduction was optimized (NG) for further studies.

In the next section, sodium alginate (SA) based blends were prepared and characterized with increasing concentrations of Glycerol (Gly). SA:Gly blends were coated on the cotton fabric to investigate change in the flexibility. These analysis indicated that presence of Gly enhanced the polymer chain mobility by disturbing the intermolecular hydrogen bonding in SA and helped in increasing the flexibility. SA:Gly blends were coated on the cotton fabric where Gly content offered good flexibility to the fabric, similar to the pristine cotton gauze. Optimized blend coated fabric was designated SG for further studies.

In the third section, increasing concentrations of three herbal extracts (Tannic Acid (TA), *Choerospondias axillaris* (CA), and *Mesua ferrea* (MF)) were added to the SG blend followed by their coating on the NG fabric. These dressings showed excellent antioxidant and antimicrobial activity in dose dependent manner. Presence of herbal extracts helped in clotting the blood faster than the control sample as measured by *in-vitro* blood clotting time analysis. Fabricated dressings showed compatibility on NIH3T3 cells suggesting their non-toxic nature.

In the last section, a comparative study of all the optimized dressings with TA, CA, and MF was carried out by *in-vivo* tail amputation test to investigate their hemostatic activity. Swiss albino mice were used for the analysis which indicated that NGSG-CA dressing has the fastest clotting time and minimum blood loss as compared to the control samples.

Overall, this work advances the field of hemostatic material development by incorporation of metal nanoparticles and herbal extracts to fabricate multifunctional dressings. These dressings can be applied to different emergency situations such as military conflicts and traumatic injuries in the near future.