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Title of thesis: Synthesis and Characterization of Chitosan based Membranes for Antimicrobial Applications

Keywords: Chitosan; Gelatin; Membranes; Crosslinker; Antimicrobial

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Abstract

The thesis presents the synthesis and characterization of chitosan (CS) bio-polymeric membranes for the antimicrobial applications. The beauty of the work carried out is the biocompatibility as well as the biodegradability. The work described in this Ph.D. thesis is divided into six main chapters:

Chapter I of the thesis deals with the background history of antimicrobial polymers: CS and gelatin (GL), their respective properties, uses, etc. A complete review of various methods used for modification of CS and their derivatives has been presented.

Chapter II deals with the blending of CS with GL. Different concentrations of CS and GL solutions were used to optimize the blending, so as to get the homogenous blend membranes. The blend membrane indicate that there was a molecular miscibility and a good interaction among these components showing homogenous nature of membranes. The influence of blending of CS with GL on other parameters such thickness, apparent density, moisture content (%), total solubility matter, transparency and light transmission of membranes, and effect on crystallinity were also investigated.

Chapter III of the thesis sums up with the crosslinking studies of CS and GL based blend membranes. The derived CS and GL based membranes have been crosslinked with different concentration of boric acid as crosslinker. On increasing the concentration of boric acid, there is increases of crosslinking on increasing its concentration. The influence of crosslinking on different parameters such as apparent density, moisture content (%), total

solubility matter, mechanical strength, transparency of membranes, and its effect on crystallinity was also investigated. The optimized membranes with suitable amount of crosslinker was further plasticized by using polyethylene glycol (PEG) so as to incorporate the flexibility into the membranes and its effect on different parameters of membranes were studied.

Chapter IV deals with the green synthesis of silver nanoparticles using *Terminalia arjuna* plant extract and their characterization using various techniques, such as UV-visible spectroscopy, X-ray diffraction (XRD), Dynamic light scattering (DLS), and Transmission electron microscopy (TEM). The synthesized silver nanoparticles were then immobilized into the polymeric membranes and the presence of nanoparticles in the membranes were then confirmed by using Scanning Electron Microscopy (SEM) and XRD. The presence of nanoparticles reduced the Water Vapour Permeability (WVP) of the membranes which may occurs due to; small size nanoparticles have more ability in occupying the empty spaces of the plasticized membrane, making difficult the diffusion of water into membranes.

Chapter V of the thesis deals with the application of CS based membranes (i.e. blended, crosslinked and/plasticized as well as nanosilver immobilized membranes) as antimicrobial agents against both gram-positive and gram-negative bacteria. The zone of inhibition of *E. coli* against the membrane of CS is larger than that of *S. aureus* and *P. aeruginosa* indicating *E. coli* is more susceptible. The addition of boric acid has significant effect on susceptibility of bacteria and *P. aeruginosa* was the most susceptible. The addition of silver nanoparticles into the membrane increase the zone of inhibition against all the strains due to presence of the inherent antimicrobial nature of nanosilver into the membrane.

Chapter VI summarizes the work highlighting the important findings of the present investigation.