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Manufacture of silver nanocomposite films for antibacterial applications

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Abstract: *Silver nanocomposite films are found to be very effective material for anti-bacterial application. In the present work, sodium carboxylmethyl cellulose silver nanocomposite films (SCMC SNCF) were tried for antibacterial applications. To enhance their applicability novel film-silver nanoparticle-curcumin composites have been developed. SCMC SNCF are developed from sodium carboxylmethyl cellulose (SCMC), N,N1 -methylenebisacrylamide (MBA) and silver nitrate solution. These films were characterized by FTIR, UV–visible, XRD, TGA, DSC and TEM techniques. The formed silver nanoparticles have an average particle size of *15 nm as observed by transmission electron microscopy (TEM). Curcumin loading into SCMC SNCF is achieved by diffusion mechanism. The UV–Visible analysis indicated that higher encapsulation of curcumin in the films with higher SCMC content. Further, it was observed that the presence of silver nanoparticles in the films enhanced the encapsulation of curcumin indicating an interaction between them. Moreover, the antibacterial activity showed that the SCMC films generated with silver nanoparticles have a synergistic effect in the antimicrobial activity against Escherichia coli (E. coli). In order improve the healing efficacy as antibacterial agents, curcumin loaded with SCMC SNCFs were developed which showed significant inhibition of E. coli growth than the silver nanoparticles and curcumin alone film. Therefore, the present study clearly provides novel antimicrobial films which are potentially useful in preventing/treating infections*

Polysaccharides are the most popular polymeric materials to prepare nanoparticles for wound dressing [1, 2] and drug delivery applications [3–5] as they are highly stable, safe, nontoxic, hydrophilic and biodegradable materials which can be easily modified chemically. Therefore, in recent years, a large number of studies have been conducted on polysaccharides for their potential application as nanoparticle drug delivery systems as well as antibacterial applications. Recently, silver-based nanostructure materials have gained much attention to control infections. The use of silver nanoparticles (AgNPs) has exhibited improved antibacterial properties than bulk silver due to high surface area and high fraction of surface atoms, leading to incorporating more NPs inside the bacteria and promoting its efficacy in a sustained manner. Water soluble polymer based biomaterials are capable of the combined antibacterial properties of AgNPs having no toxicity. Basing on this, numerous polymers have been employed to prepare polymer-silver nanocomposites. The combination of silver nanoparticles with water soluble biopolymers will produce new antimicrobials. Among the various biopolymers, Carboxymethyl cellulose is widely used in drug delivery and wound dressing applications. The reason is its biocompatibility, and biodegradable nature with enormous metal complexation capacity. In particular, sodium carboxymethyl cellulose (SCMC) is currently used in oral, pharmaceutical formulations and as tablet binder as well as metal stabilization properties which enhanced the biomedical applications. For these applications, it is important to have good stability of nanoparticles in films Vimala et al. developed polysaccharide silver nanoparticle films for antibacterial applications. Ce´dric Chauvierre et al. used the based on polysaccharide based poly(alkylcyanoacrylates) nanoparticle templates for drug delivery applications. We recently reported the studies on chitosen based silver nanoparticle films which possessed superior antibacterial activity. The objective of this study was to improve the swelling and mechanical properties as well as improved wound dressing properties of film by generating of silver nanoparticles as shown in Scheme 1. The developed SCMC silver nanoparticles composite films were analyzed by of UV–Vis, fourier transform infrared (FTIR) spectrophotometric, thermogravimetric analysis (TGA), differential scanning calorimetry (DSC) and transmission electron microscopy (TEM) techniques. Curcumin (CM), a hydrophobic polyphenolic compound derived from the rhizome of the herb curcuma longa, possesses a wide range of biological activity including wound healing, anti-bacterial, anti-oxidant, anti-inflammatory and anti-cancer properties. Hence, this compound was incorporated into SCMC SNCF to improve significantly the therapeutic antibacterial efficacy of the film. The effect of AgNPs and curcumin on the antibacterial activity of the films was studied

In this work we successfully obtained curcumin nanocomposite systems based on polysaccharides and silver nanoparticles. These composites were developed and characterized by spectral, thermal, X-ray diffraction, and electronic microscopic studies. The developed silver nanocomposite films exhibited fairly good mechanical strength and superior antimicrobial properties. Further, the current work demonstrates a promising method to combine silver nanocomposites with a natural compound (curcumin) in developing novel antimicrobial agents. These agents may find potential applications in antimicrobial packaging materials and wound/burns dressing

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