Physical and antimicrobial characterization of self assembled silver nanoparticle/chitosan onto low density polyethylene film as active packaging polymer

ABSTRACT

Colloidal Silver nanoparticles with a size of 5 nm produced by chemical reduction using poly ethylene glycol (PEG 200). Layers of silver nanoparticles and chitosan were deposited onto low density polyethylene (LDPE) substrate by layer by layer (LBL) self-assembly technique. Silver nanocomposite films were built by sequential dipping of LDPE film in either anionic silver nanoparticles or cationic chitosan. Silver nanoparticles and chitosan led to the formation of nanocomposite films possessing antimicrobial properties with the thickness of 2, 4, 8, 12 and 20 layers. Silver nanocomposite films were characterized by atomic force microscopy (AFM). Thermal, mechanical and barrier properties of LBL deposited nanocomposite films were investigated. Results showed that the LBL deposition of silver nanoparticles and chitosan increased the crystallinity of the composites and also improved mechanical and barrier properties of LDPE film significantly ($p<0.05$). Antimicrobial activity of silver nanocomposites against Escherichia coli and Staphylococcus aureus was evaluated. Growth kinetic parameters of E.coli and S.aureus affected by silver nanocomposites were calculated by modeling of absorbance data according to Gomperz equation. LDPE-silver nanocomposite affected bacterial growth parameters significantly ($p<0.05$). The specific growth rate reduced from 0.30 to 0.11 h-1 for E. coli and decreased 0.27 to 0.06 h-1 for S. aureus.

Keyword: Active polymer; Chitosan; Layer by layer deposition; Silver nanocomposite