ABSTRACT

Although silver is used as key component to control microbial proliferation in countless applications, available silver based technologies are scarce. This relies in the difficulties in assessing silver efficacy due to stability and speciation issues. In the present dissertation, silver ions were directly incorporated into biopolymer matrices as to obtain materials with prolonged antimicrobial performance based on the sustained release of silver ions. A profound insight into the chemical interactions between the active silver species and both bacteria and the environment of action was carried out as to correctly assess silver efficacy in the subsequent design of the antimicrobial materials. Silver was found to be effective at the nanomolar level under optimum conditions. However, time dependent chemical interactions with several ligands drastically affected silver efficacy and the assessment of viability by traditional enumeration methods. The incorporation of silver ions into EVOH films produced by casting and electrospinning did not alter the physicochemical properties of the materials and showed a rapid release of the whole silver content upon contact with moisture. This was reflected in inactivation of bacteria at very low silver loadings (0.0001wt.%) under optimum conditions. When incorporated in PLA by casting or melt compounding, the release of silver ions and antimicrobial performance was prolonged from days to months depending on the silver content or the method for incorporation. Release was also found to be highly dependent on moisture content and pH. An initial burst release stage was attenuated by the application of a beeswax layer, which allowed the release profiles to be tailored to suit a specific release profile and comply with current legislation. The films demonstrated a high antibacterial and antiviral effect against the most common food-borne pathogens in synthetic media, real liquid and solid food samples as well as on the surface of the films. This study represents a step forward in the understanding of silver antimicrobial efficacy and puts forth its possible suitability for food packaging, food contact or other applications.