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Imino-chitosan biopolymeric films. Obtaining, self-assembling, surface and antimicrobial properties

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ABSTRACT

The paper reports the preparation of twelve imino-chitosan biopolymer films by acid condensation of the amino groups of chitosan with various aldehydes, in aqueous medium, followed by slow water removal. FTIR spectroscopy has shown drastic conformation changes of chitosan macromolecular chains – from a stiff coil to a straight one, while wide angle X-ray diffraction evidenced a layered morphology of the biopolymer films. Contact angle and surface free energy determination indicated a higher biocompatibility of the new biopolymers as compared to the chitosan parent, while the microbiological screening demonstrated their self-defense properties against common and virulent pathogen agents. It was concluded that the reversibility of imine forming promotes the self-assembling of imino-chitosan biopolymer films into a lamellar morphology and, on the other hand, the slow release of the antimicrobial aldehyde in the microbiological culture.

The obtained results demonstrate that chitosan polyamine is a challenging workbench to functional biodynamic materials.

1. Introduction

Prevention of pathogen colonization on food packaging, biological filters, medical implants, medical indwelling devices or ordinary medical devices coming into contact with patients is a major medical and financial matter since infections by microorganisms represent one of the most serious health care complications. To overcome this problem, the development of active antimicrobial materials received considerable attention over the last decades in both building and coating of medical devices (Ferrero, Periolatto, Vineis, & Varesano, 2014; Muzzarelli & Muzzarelli, 2009; Muzzarelli, Tanfani, Emanuelli, & Mariotti, 1982; Nada et al., 2014). In addition, the materials addressed to obtaining of medical implants or medical indwelling devices must be biocompatible, to ensure a good cellular adhesion. Higher cell adhesion and proliferation has been reported for nanostructured films, this demonstrating that morphology is an important feature of the materials coming in direct contact with tissues (Park et al., 2013).

In this context, to meet the long life and easy manufacturing requirements, material formulations include antimicrobial biocompatible polymers. Chitosan is one of the most recommended candidates due to its good biocompatibility, therapeutic properties and lack of toxicity against human body or environment (Croisier & Jérôme, 2013; Muzzarelli, Littarru, Muzzarelli, & Tosi, 2003; Ravi Kumar, Muzzarelli, Muzzarelli, Sashiwa, & Domb, 2004). Besides, the well-known manufacturing of chitosan as films (Saito, Luchnikov, Inaba, & Tamura, 2014), bio-PDLC composites (Marin, Popescu, Zabulica, Uji, & Fron, 2013), micro- and nano-fibers (Yudin et al., 2014), nanoparticles (Sanjai, Kothan, Gonil, Saesoo, & Sajomsang, 2014) or hydrogels (Muzzarelli, 2009; Muzzarelli, Ilari, Xia, Pinotti, & Tomasetti, 1994) further enhances its value, chitosan being of interest for a large number of biomedical, cosmetic, food

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