Ref: 3267

Edible lactoferrin bacterial cellulose films as an effective and low-cost antimicrobial active packaging

Padrão, Jorge[1]; Gonçalves, Sara[1]; P. Silva, João[1]; Sencadas, Vitor[2,3]; Lanceros-Méndez, Senentxu[2]; C. Pinheiro, Ana[1]; Vicente, António[1]; R. Rodrigues, Lígia[1]; Dourado, Fernando[1]

[1]Centro de Engenharia Biológica, Universidade do Minho, Campus Gualtar, 4710-057 Braga, Portugal;
[2]Centro/Departamento de Física da Universidade do Minho, Campus de Gualtar, 4710-057 Braga, Portugal;
[3]Escola Superior de Tecnologia, Instituto Politécnico do Cávado e do Ave, Campus do IPCA, 4750-810, Barcelos, Portugal

E-mail: padraoj@deb.uminho.pt

Keywords: Bacterial cellulose, lactoferrin, active packaging, antimicrobial, artificial digestive system, functional food

Abstract

Active packaging is an increasingly reliable technology for assuring the safety and maintenance/improvement of the organoleptic traits of the enclosed food products. Bio-based materials with a wide set of highly impressive characteristics were assembled through a simple and effective methodology to produce affordable edible antibacterial active films. Bacterial cellulose (BC) was used as film scaffold since it is an extremely pure polysaccharide that possesses noteworthy properties for food casing such as high toughness, shape retention and works as a stabilizing agent. Functionalization of BC was achieved through absorption of lactoferrin (LF), a bilobar protein mainly extracted from milk that possess a numerous plethora of activities, such as broad spectrum antibacterial effect, immunoregulatory properties, and also promotes bifidobacteria and intestinal epithelium growth. These films were extensively characterized in terms of their physicochemical characteristics, bactericidal efficiency and cytotoxicity. The LF absorption and de-absorption profiles of the BC films were registered. Surface free energy, water vapour permeability, attenuated total reflection Fourier transform infrared spectroscopy, dynamic mechanical analysis (in water saturated conditions) and swelling profile, and other critical characterization techniques were employed. The antibacterial properties were assessed through the determination of the specific growth rate impact, “live and dead” fluorescence, scanning electron microscopy and colony forming units’ count; using two model microorganisms (*Escherichia coli* and *Staphylococcus aureus*). The contact killing properties were evaluated for standalone films and for a specific case study (fresh sausage). Finally, the films cytotoxicity was determined after digestion in a dynamic mimetic artificial gastrointestinal digestive system. All attained results lead us to conclude that the obtained active edible films display an effective and significant antimicrobial activity

against both Gram – and + and revealed no cytotoxicity, prior and after the gastrointestinal digestion. Thus, these new films present a high potential to safely functionalize the encased foods, while providing prophylactic properties.

Acknowledgements: The authors acknowledge the Portuguese Foundation for Science and Technology (FCT, Portugal) for the financial support provided by the research grants SFRH/BD/64901/2009, SFRH/BD/63578/2009, SFRH/BPD/64958/2009, SFRH/BPD/64958/2009 for Jorge Padrão, Sara Gonçalves, João P. Silva and Vitor Sencadas respectively, and also for FCT Strategic Project PEst-OE/EQB/LA0023/2013