K-CARRAGEENAN/CHITOSAN NANOLAYERED COATING AS A VEHICLE FOR INCORPORATION OF BIOACTIVE COMPOUNDS

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Introduction

Nanotechnology holds a great potential to generate very innovative solutions for food industry and packaging is one of the many areas that can benefit from this new technology. Layer-by-layer (LbL) assembly is based on the alternating deposition of oppositely charged polyelectrolytes and can be applied to produce nanolayered coatings, which can be specially engineered to incorporate and allow the controlled release of bioactive compounds. Nanolayered coatings have promising applications in food systems such as fresh-cut fruits and vegetables or cheese, however for these applications to be possible, biofunctionality and the use of non-toxic materials are the most fundamental conditions to be met. Therefore, natural polyelectrolytes such as chitosan (cationic polysaccharide with antimicrobial activity) and κ-carrageenan (sulphated anionic polysaccharide with good film forming properties) are competitive candidates as materials for the formation of nanolayered coatings.

In this work a nanolayered coating was prepared by LbL deposition of κ-carrageenan and chitosan onto aminolyzed/charged polyethylene terephthalate (PET) and the coating was characterized in terms of its permeabilities and surface properties. In order to evaluate the ability of this nanolayered coating to act as a vehicle for bioactive compounds incorporation, the model compound methylene blue (MB) was incorporated and its loading and release behaviour was evaluated.

Results and Discussion

The nanolayered coating composed of three κ-carrageenan and two chitosan layers has been successfully assembled on PET substrate, as confirmed by the increase of absorbance, changes in the contact angle and SEM. The κ-carrageenan/chitosan nanolayered coating exhibits exhibit good gas barrier properties (WVP = $(0.020 \pm 0.002) \times 10^{-11}$ g.m^{-1}.s^{-1}.Pa and $O_2P = (0.043 \pm 0.027) \times 10^{-14}$ g.m^{-1}.s^{-1}.Pa).

MB was successfully incorporated on the κ-carrageenan/chitosan nanolayered coating (Figure 1a) and the results of fitting the Linear Superimposition Model (LSM) to the experimental data of MB release suggest an anomalous behaviour, with one main polymer relaxation (Figure 1b). The effects of layer position, temperature and pH on MB release were evaluated and different results were observed depending on the position of MB incorporated on the nanolayered coating or the pH and temperature of the medium.

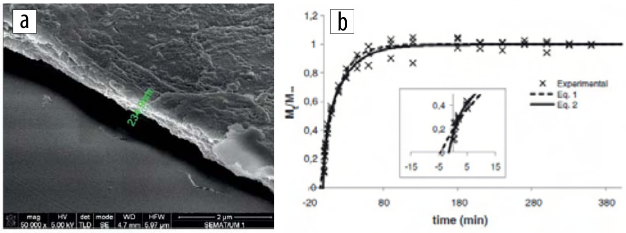

Figure 1: SEM images of the κ-carrageenan/chitosan nanolayered coating incorporating MB (a); example of Fick's (Eq. 1) and LSM (Eq. 2) description of MB release from the 4th at pH=2 (inserts show the detail of the model fitting).

Conclusions

The developed biodegradable nanolayered coating is a promising delivery system for application in food products, as a strategy for shelf-life extension.

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