Influence of electric field in the physical and transport properties of chitosan coatings

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Edible films and coatings can provide additional protection for food, while being a fully biodegradable, environmentally friendly packaging system. The aim of this work was to determine the effect of field strength on functional properties of chitosan coatings. Different field strengths were applied during the preparation of the film forming solution, films were cast and, for each electric treatment, the water vapor, O2 and CO2 permeabilities of the films were determined, together with their solubility in water and mechanical properties. The films were also analysed using scanning electron microscopy (SEM) and X-ray diffractometry (XRD).

The results showed that the electric field has statistically significant effects on films' transport properties (which e.g. for water vapour permeability, varied from 0.3228 to 0.2667 $(g.(m.day.atm)^{-1})$) and structure, a positive correlation having been found between the water vapor, O_2 and CO_2 permeability coefficients and the applied field strength.

XRD analyses indicated that electrically treated chitosan films exhibited a more ordered structure and a clearly higher crystallinity when compared with non-treated films, thus displaying significant effects on the value of the crystallinity index (CI). SEM micrographs evidenced that the surface morphology of chitosan films was influenced by the electric field. In fact, the electric field treatment led to a structure with more regular layers. The application of the electric field to chitosan film-forming solutions resulted in an increase of the tensile strength (ca. 9 %) and elongation-at-break (ca. 18 %) of the corresponding chitosan films. The reported results demonstrate that the application of an electric field to film-forming solutions of chitosan is an interesting instrument to tailor relevant properties of the films or coatings produced from them.