REINFORCEMENT OF POLYSACCHARIDE-BASED FILMS: EVALUATION OF PHYSIC-CHEMICAL PROPERTIES

M. A. Cerqueira, A. A. Vicente

IBB – Institute for Biotechnology and Bioengineering, Centre for Biological Engineering, University of Minho, Campus de Gualtar, Braga, Portugal.

miguelcerqueira@deb.uminho.pt

Currently, mainly non-biodegradable petroleum-based synthetic polymers are used as packaging materials for foods, because of their availability, low cost and functionality. However, biodegradable/edible films can be made from polysaccharides, proteins, and lipids without the environmental issues of petroleum-based polymers and with the additional advantage of being available from renewable sources or as by-products or waste-products from the food and agriculture industries. Recently, improvements on properties of these films have been made by reinforcement of the polymer matrix with other materials. Several materials (e.g. micro/nano clays, lipids and hemicelluloses) were studied in order to show how they could be used to improve physico-chemical properties. Polysaccharide based-films (i.e. chitosan, galactomannan and k-carragennan) were reinforced by the additon of Cloisite 30B, micro/nano clays, lipids and hemicellulose wheat straw and their properties evaluated. Different concentrations of compounds were added to polysaccharide-based films and barrier properties (water vapor permeability, WVP; CO_2 and O_2 permeabilities) and mechanical properties (tensile strength, TS and elongation at break, EB) were determined. In some cases the film structure was investigated by X-ray diffraction (XRD), scanning electron microscopy, Fourier transformed infrared and thermal properties.

According to the nature of the added compounds different behaviours were observed on film properties. Results showed that the incorporation of micro/nano clay or Cloisite 30B in the films significantly affected their mechanical and barrier properties[1,2]. An increase of the micro/nano clay concentration caused a decrease of WVP and an increase of TS. However, they showed different influences in O_2 and CO_2 permeabilities and EB (e.g. Cloisite 30B decreased permeabilities and micro/nano clay did not influence this property). These differences could be explained by the size of the compounds added and by the degree of exfoliation of compounds in the films (as shown by the XRD patterns of the films). When adding corn oil to films a more hydrophobic structure was observed with the decrease of the affinity of film matrix to water[3]. This change will enhance the WVP (i.e. lower values) of the films and change the mechanical properties. Also different behaviours according to the type of polysaccharide used were observed, explained by the specific sorption sites for water of both polysaccharide-based films (i.e. O-H groups or O-H and/or NH_2 groups). Glass transition temperature and crystallinity of the films gave the indication of changes on the structure of the films after the addition of corn oil. Also the addition of hemicellulose influenced the properties of polysaccharide-based films decreasing water affinity of the films (i.e. lower moisture content and WVP) and increasing their mechanical performance (higher TS and EB), explained by the increase of the matrix crystallinity[4]. Also important to mention is the antimicrobial behaviour of polysaccharide films with incorporation of Cloisite 30B that shows an inhibitory effect against L. monocytogenes[2].

Polysaccharide-based films can be reinforced, and their properties enhanced, being compounds such as clays, lipids, and hemicelluloses valuable alternatives for the improvement of polysaccharide-based films properties (water vapour transmission, mechanical, thermal).

References

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