

Effect of plasticizer and oil concentration on water content and mechanical, transport and solubility properties of polysaccharide-based films

Cerqueira, M.A.¹; Souza, B.W.S¹, Teixeira, J.A.¹, Vicente, A.A¹

¹IBB-Institute for Biotechnology and Bioengineering, Centre of Biological Engineering, Universidade do Minho, Campus de Gualtar 4710-057, Braga, Portugal

e-mail: avicente@deb.uminho.pt

Abstract

Edible films from natural sources as chitosan and galactomannan can be a promising solution to the environmental problem of oil-based plastic waste disposal. They can provide additional protection for food, while being a fully biodegradable, environmental friendly packaging system. One of the main disadvantages of biopolymers is that they naturally interact with water, leading to textural transformations that have a strong impact on their mechanical, transport and solubility properties. The presence of oil and plasticizer can greatly influence the water content of polysaccharide films. This work evaluates the influence of glycerol (plasticizer) and corn oil presence on film properties. Films of 1.5 % (w/v) of polysaccharide (chitosan or galactomannan) were supplemented with glycerol in concentrations of 0, 0.5, 1.25 and 2.0 % (w/v). Further, films with 1.5 % of polysaccharide and 0.5% of glycerol were supplemented with corn oil in concentrations of 0.25, 0.5 and 0.75 %. The water content was determined by moisture loss (at 105 °C) and confirmed by Fourier transform infrared (FTIR) spectra. The increase of glycerol concentration lead to an increase of water content, which in turn decreased with the presence of oil. This behaviour was related with film properties: solubility, water vapour permeability (WVP) and mechanical properties (tensile strength - TS and elongation at break - E) were evaluated, together with the opacity and colour.

The addition of glycerol lead to an increase of the water content of chitosan films from 9.93 to 32.62% and of the solubility from 42.25 to 69.94%. The same happened with galactomannan films, where an increase of glycerol concentration lead to higher values of both water content (from 10.60 to 44.25%) and solubility (from 22.00 to 65.43%). The results indicate that the addition of oil improves the hydrophobic properties of the films resulting in a decrease of the WVP values. In fact, WVP was highly influenced by the addition of glycerol and corn oil, displaying values ranging from 5.07 to 11.38 10^{-11} g (m s Pa)⁻¹ and 6.60 to 13.02 10^{-11} g (m s Pa)⁻¹ for chitosan and galactomannan films, respectively. The mechanical properties show to be highly influenced by the increase of the plasticizer concentration. Chitosan films have E and TS values ranging between 16.2 and 78.3% and 1.3 and 17.5 MPa, respectively. For galactomannan films the values of E ranged from 3.8 to 44.0% and TS values ranged from 2.7 to 17.5 MPa. Opacity shows a decrease with plasticizer addition and an increase with oil addition.

This work shows that polysaccharide edible films properties are significantly influenced by the presence of plasticizer and/or oil changing the way the polysaccharide network adsorbs water, having a strong influence in their transport, mechanical and solubility properties.

