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Functional properties of chitosan-based films

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ABSTRACT

Chitosan-based films plasticized with glycerol were prepared by casting with the aim to obtain environmentally friendly materials for packaging applications. Different contents of glycerol were incorporated into chitosan solutions to improve mechanical properties and all films obtained were flexible and transparent. It was observed that the transparency and good behaviour of the films against UV radiation were not affected by chitosan molecular weight or glycerol content. Moreover, chitosan-based films exhibited excellent barrier properties against water vapour and oxygen, even with the addition of glycerol. The effect of the plasticizer on the properties has been explained using Fourier transform infrared (FTIR) spectroscopic analysis. The changes observed in the intensity of the bands showed that glycerol interacts with chitosan, which could be confirmed by total soluble matter (TSM).

1. Introduction

Nowadays there is an increasing interest in biodegradable/compostable polymers from renewable sources due to the environmental problems caused by conventional food packaging materials. Films prepared with these polymers are usually based on polysaccharides, proteins and lipids, which are generally biodegradable, nontoxic, and some of them are effective barriers to oxygen and carbon dioxide, so they can be used as protective coating to maintain food quality and, at the same time, reduce the environmental impact of packaging wastes. Moreover, there is a growing interest to develop materials with antimicrobial character to prevent alterations in food caused by microorganisms' contamination and, in this context, chitosan is an interesting film forming material (Dutta, Tripathi, Mehrotra, & Dutta, 2009).

Chitosan is the second most abundant polysaccharide found in nature and has non-toxic, biodegradable, and antimicrobial characteristics, which are of great interest for packaging purposes. Chitosan is a natural polymer derived by deacetylation of chitin, which is insoluble in usual solvents. However, when the degree of deacetylation of chitin reaches about 50%, it becomes soluble in aqueous acidic media and is called chitosan (Rinaudo, 2006). The solubility of chitosan depends on the degree of deacetylation, the distribution of acetyl groups along the main chain, the molecular weight and the nature of the acid used for protonation (Pillai, Paul, & Sharma, 2009), but it is soluble in dilute acid solutions below pH 6.0 due to the presence of amino groups. Apart from solubility, chitosan molecular weight can also affect the quality of the final film such as elasticity or brittleness (Hwang, Kim, Jung, Cho, & Park, 2003; Park, Marsh, & Rhim, 2002).

Owing to its film forming properties and antimicrobial character, chitosan is a potential material for packaging films. However, chitosan films are rigid and need plasticizers to reduce frictional forces between polymer chains, such as hydrogen bonds or ionic forces, in order to improve mechanical properties (Olabarrieta, Forsström, Gedde, & Hedenqvist, 2001; Park et al., 2002; Suyatma, Tighzert, Copinet, & Coma, 2005; Ziani, Oses, Coma, & Maté, 2008). The incorporation of polyols in the formulation of the film can overcome this drawback (Srinivasa, Ramesh, & Tharanathan, 2007) and keep film mechanical properties stable during the required time (Kerch & Korkhov, 2011; Osés, Fernández-Pan, Mendoza, & Maté, 2009).

Barrier properties in food packaging are of great importance. Interaction between oxygen or water vapour and the product could deteriorate food quality (Srinivasa, Baskaran, Ramesh, Harish Prashanth, & Tharanathan, 2002). One of the main functions of food packaging films is to retard oxygen and moisture transfer between food and the environment, so that oxygen permeability (OP) and water vapour permeability (WVP) should be as low as possible in order to increase the shelf-life of the product (Gontard, Guilbert, & Cuq, 1992).

The goal of the present work was to prepare films based on chitosans of different molecular weights to improve mechanical properties of the biofilms by the addition of glycerol. This paper mainly studied the influence of the chitosan/glycerol ratio and molecular weight of chitosan on the functional properties of the

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