Journal of Food Engineering 107 (2011) 41–49

Contents lists available at ScienceDirect

Journal of Food Engineering

journal homepage: www.elsevier.com/locate/jfoodeng

Characterization of soy protein-based films prepared with acids and oils by compression

P. Guerrero [a], Z.A. Nur Hanani [b], J.P. Kerry [b], K. de la Caba [a,*]

[a] Department of Chemical and Environmental Engineering, University of the Basque Country, Polytechnic School, Donostia-San Sebastián, Spain
[b] Food Packaging Group, Department of Food and Nutritional Sciences, University College Cork, Ireland

ARTICLE INFO

Article history:
Received 1 April 2011
Received in revised form 24 May 2011
Accepted 2 June 2011
Available online 12 June 2011

Keywords:
Soy protein
Lactic acid
Oils
Compression
Films
Characterization

ABSTRACT

Soy protein-based films modified with gelatin and plasticized with glycerol were prepared by compression at pH 10. The effect of different contents of lactic acid, epoxydized soybean oil and olive oil on optical, barrier, and mechanical properties was investigated and results were related to changes in the bands obtained by Fourier infrared spectroscopy and thermo-gravimetric analysis. The observed changes indicated interactions of the small molecules of lactic acid with protein and glycerol, which also caused the improvement in the hydrophobic character of the films, maintaining water vapour permeability and good values for puncture and UV barrier properties and, at the same time, decreasing the typical yellowish colour of soy protein based films.

1. Introduction

Considerable interest in biopolymer films has been renewed due to their environmentally friendly nature and their potential use in food and packaging industries (Krochta and de Mulder Johnston, 1997). Biopolymers from various natural resources such as starch, cellulose, and protein have been considered attractive alternatives for non-biodegradable petroleum based plastics. Proteins are generally superior to polysaccharides in their ability to form films with greater mechanical and barrier properties (Cuq et al., 1998) and they could be an alternative resource to bioplastics in packaging applications since they are abundant, renewable, environmentally friendly, and biodegradable (Paetau et al., 1994; Swain et al., 2004). Soy protein isolate (SPI) films present adequate properties to be used as food packaging, such as they have very low aroma and oxygen permeability (Gennadios et al., 1993; Ghorpade et al., 1995), which makes them useful for applying to sensitive to oxygen products or for preserving flavours. Nevertheless, their high water vapour permeability is an obstacle to use them in food packaging (Rhim et al., 2000).

Different ways have been discussed in the literature in order to improve water barrier ability of biofilms, such as the addition of polysaccharides, other proteins, or lipids. Blending other natural polymers with SPI materials has been an approach to modify the moisture sensitivity of SPI films. Normally, these blends' components are starch or cellulose, which are also biodegradable polymers, to ensure that the final blend films can still be regarded as "green" (Rhim et al., 1998; Rodríguez et al., 2006).

Cao et al. (2007) and Guerrero et al. (2011) produced SPI-gelatin films in which tensile strength and elongation at break increased at the same time by increasing gelatin ratio, as well as films became more transparent and easier to handle. However, it was observed that gelatin was not able to provide a significant moisture barrier.

Lipids can be also used in composite films to improve films' ability to control water transport. Rhim et al. (1999) combined SPI with lauric, palmitic, stearic and oleic acids, finding out that the incorporation of fatty acids decreased water vapour permeability of films. Monedero et al. (2009) also found a decrease in water vapour permeability of SPI when protein was mixed with beeswax and oleic acid.

As cited above, many attempts have been made to modify the poor surface hydrophobicity of biofilms. However, as SPI contains 58% polar amino acids that cause its hydrophilicity, its moisture sensitive is difficult to eliminate (Rhim and Lee, 2004). In this work, epoxydized soybean oil (ESO), virgin extra olive oil variety picual (OO) or lactic acid (LA) have been added to SPI-based films in order to improve the hydrophobic character of the films prepared by compression. Therefore, the aim of this work is to improve contact angle values, maintaining water vapour permeability, optical, and mechanical properties obtained in the control films previously prepared (Guerrero et al., 2011). Results were related to interactions

* Corresponding author.
E-mail address: koro.delacaba@ehu.es (K. de la Caba).

0260-8774/$ - see front matter © 2011 Elsevier Ltd. All rights reserved.
doi:10.1016/j.jfoodeng.2011.06.003