Optical and mechanical properties of thin films based on proteins

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Glycerol-plasticized soy protein thin films were prepared with two different disaccharides: lactose and sucrose. The effects of the type and concentration of each additive on optical, mechanical and barrier properties were measured and the results were related to the structure observed by XRD. Results indicate that the hydrophobic character, water vapor permeability, and flexibility of the films were improved by Maillard reaction.

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1. Introduction

The use of renewable resources to produce biodegradable materials with good properties is an area of work that has been of great interest in recent years [1,2]. These materials could reduce the use of petroleum-derived polymers and contribute to the development of environment friendly materials. In this context, soy proteins could be potential alternatives since they are abundant, have relatively low cost and interesting functional properties. In recent years, the use of petroleum-derived polymers and contribute to the development of environment friendly materials. In this context, soy proteins could be potential alternatives since they are abundant, have relatively low cost and interesting functional properties.

2. Materials and methods

Materials: Soy protein isolate (SPI) with 90% minimum protein content on dry basis was obtained from Lactotecnia S.L., Barcelona (Spain). Glycerol (GLY) used as a plasticizer, and lactose (LAC) and sucrose (SUC) used as crosslinkers were supplied by Panreac. (Spain). Glycerol (GLY) used as a plasticizer, and lactose (LAC) and sucrose (SUC) used as crosslinkers were supplied by Panreac.

Film preparation: Film-forming dispersions were prepared by mixing SPI, LAC and SUC in distilled water. Dispersions were heated at 80 °C for 30 min under magnetic stirring. Then, 20 wt% GLY was added and dispersions were maintained at 80 °C for another 30 min. Dispersions were poured into Petri dishes and dried at room temperature to obtain films. Films were designed as SPI/GLY, SPI/GLY/SUC or SPI/GLY/LAC as a function of the composition. All films were conditioned in a climatic chamber (ACS SU700V) at 25 °C and 50% relative humidity for 48 h prior to testing.

Color measurement: Color was determined with the colorimeter Konica-Minolta CR-400 Chroma Meter. Films specimens were placed on the surface of a white standard plate, and color parameters L (lightness), a (redness), b (yellowness) were measured using the CIELab color scale. Color difference (ΔE) was referred to a pattern sample and calculated as follows:

\[
\Delta E = \sqrt{(\Delta L)^2 + (\Delta a)^2 + (\Delta b)^2}
\]

Contact angle determination: Water contact angle measurements were performed at room temperature using a contact angle system (model OCA 20). 3 µl droplet of distilled water was placed on the film surface to estimate the hydrophobic character and the image of the drop was carried out using SCA20 software.

Water vapor permeability (WVP): WVP was determined according to ASTM E96-00. The sample film was cut into a circle of 7.40 cm diameter and the test area was 33 cm². The setup was subjected to temperature and relative humidity of 38 °C and 90%, respectively. WVP was calculated as

\[
WVP = \frac{WVTR \times L}{\Delta P}
\]