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Development of Biodegradable Films Based on Cellulose Derivatives and Pectin for Food Packaging

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Abstract

Nowadays, solid wastes generated from various industrial, domestic or agricultural activities have created serious environmental problems. The impact of different types of packaging (paper, plastic, metal i.e.) on the environment has reached a critical stage all over the world. Currently, it is a high interest in the use of biodegradable polymers over non-biodegradable synthetic polymers obtained from petroleum and which create major environmental problems. Biodegradable polymers such as cellulose, cellulose derivatives, pectin, starch, lignin, and polyester have lower mechanical, barrier and thermal properties compared to synthetic polymers. Thus, in order to replace non-biodegradable polymers with biodegradable polymers, the characteristics of biodegradable polymers must be improved by various methods, such as mixing with synthetic polymers or natural polymers. The aim of this study was to develop biodegradable films for food packaging. A biodegradable films were obtained by casting method using three cellulose derivatives, pectin and glycerol as plasticizer. The thickness and mechanical properties (tensile strength, elongation at break and elastic modulus) of biodegradable films are basic characteristics that have been investigated to ensure the integrity of food packaging under the influence of external factors. The films obtained with hydroxypropyl methyl cellulose (HPMC) had the highest thickness (93.1±5.56 mm) compared to those obtained with hydroxyethyl cellulose (HEC) (58.7±3.48 mm). The HEC films had the highest elongation value of 13.27% and the lowest tensile strength of 28.18 MPa. The highest value for tensile strength was recorded for HPMC films 60.04 MPa. Close values for elongation at break were reported for the films obtained from carboxymethyl cellulose (CMC) and HPMC, 8.71% and 9.12%, respectively. The hardness of the biodegradable films was also determined, this characteristic being important during the handling, transport and storage of food products. The lowest value for hardness was 245.90±15.53 HL for HEC film and the highest value was 526.9±10.50 HL (CMC film). The moisture content of the biodegradable films was 8.25 – 11.72%, while the water activity (a_w) was 0.29 – 0.35 which ensured information about their microbial stability. The barrier properties of films, such as

water vapor transmission rate (WVTr) of the biodegradable films were determined between 1.14 and 1.87 $g*m^{-2}*day^{-1}*atm^{-1}$. The light transmission, transparency and modifications in the structure of the biodegradable films were investigated using spectroscopy.

Keywords: carboxymethyl cellulose, hydroxyethyl cellulose, hydroxypropyl methyl cellulose, pectin, ATR-FT-IR

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