Physicomechanical properties of films basd on agroindustry residues: orange and lemon peel

Katiushka Arevalo, Carlos Solis, Luis J. Galan, Socorro Flores
Institute of Biotechnology, Faculty of Biology, Universidad Autonoma de Nuevo Leon.

Keywords: derived materials, natural resources

Statement of Purpose: The benefits of naturally occurring polymers for material applications are important because their environmental compatibility. In addition, the use of renewable recourses provides an incentive to extend nonrenewable petrochemical supplies. The agriculture industry produces sufficient supplies of some agricultural products that could be used as renewable sources for polymer feed stocks. Biodegradability is an additional benefit of renewable polymers. Composites of polymers from renewable resources offer an answer to maintain a sustainable development of economically and ecologically attractive technology. A variety of naturally occurring biopolymers can be found. Some of these such as cellulose and starch are very actively used in several products today, while many other remain underutilized. The main objective of this study was to evaluate the physic- mechanical and barrier properties of films prepared from agro-industry residues.

Methods: Lemon and orange peel wastes were obtained from Oranjugos, Co., Monterrey, N.L., Mexico, they were grounded by 72 hrs and passed through a mesh No. 120 until homogeneus particle size. Commercial grade glycerol (99.5%), Polyvinyl alcohol (PVA) and anionic starch were purchase from Analytika ®, Arivol ® 540 and Amifilm ®, respectively. Anionic pectin solution with concentration of 2.35% (W/V) was prepared by dispersing it in the distilled water, the lemon peel or orange peel or starch solution were added respectively and stirring until they dissolved completely. The PVA (41.1% W/V) was added as plasticizer and after complete solubilization the glycerol (2% W/V) was added to the solution and stirred for 30 min. The different solutions were then cast onto non stick glass plates (20 X 20 cm) by spread them with a blade height of 1 mm. The plates were placed for 24 h at room temperature for drying. Thickness of the films was measured with a precision digital micrometer (Digimatic Indicator Mod. 293, Mitutoyo Corporation, Japan). All films were conditioned prior to subjecting them to permeability and mechanical tests according to Standard method, D618-61 (ASTM, 1993a). Films used for testing water vapor permeability (WVP), tensile strength (TS) and elongation (E) were conditioned at 60% RH and 27±2°C by placing them in a desiccators over a saturated solution of Mg $(NO_3)_2$ $.6H_2O$ for 72 h or more. For other tests, film samples were transferred to plastic bags after peeling and placed in desiccators. The mechanical properties were studied using an Electronic Tensile Tester Mod: QC II-XS, in accordance with ASTM D-882-91 (1996). The water vapor transmission rate was made using the standard method, E 97-87 (ASTM 1989). Analyses by scanning electron microscopy (SEM) were done using a Jeol microscopy.

Results: Films made in this study, showed tensile strength values between 2.550 ± 0.161 and 9.282 ± 0.926 MPa, which coincide with those reported by several authors, who used materials of similar nature (Romero-Bastida et al 2004; Fishman et al 2006; Meneses et al., 2007. Elongation values presented by the films under study ranged between 2.91 and 16.21%, showing a high significant difference between the formulations based on lemon peel and orange peel. Permeability values at time 0, after 24 hrs of test ranges between 6.150 E^{-5} g H_2O/mm^2 h in the formulation based on orange peel whereas the lowest value corresponded to 1.613 E^{-5} g H_2O/mm^2 to the films elaborated with lemon peel. The thickness of the films under study ranged from 1.017 ± 0.141mm and 2.386 ± 1.292mm. The thickness is a factor that directly depends on the chemical composition and concentration of the material, which is mainly due to the interaction of active organic groups capable of generating atomic interactions in the macromolecule when the components are mixed in solution, and this depends on the structural behavior at the surface. The microscopy analyses showed films with smooth surfaces for the formulations prepared with both agro-industry residues Fig. 1 and Fig. 2.

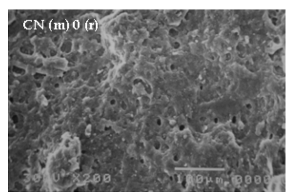

Fig.1Orange peel waste films

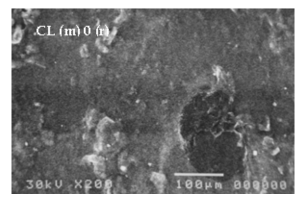

Fig. 2 Lemon peel waste films

Conclusions: in the films prepared from orange peel, no significant difference was found in the percent elongation parameter, the values obtained ranged between 2.9 and 4.6%. However, films based on lemon peel, it was observed that the percent elongation is greater than the films prepared from orange peel, however the values are lower than films produced with synthetic polymers like low density polyethylene (LDPE). By other hand we can state that the microstructure of the two types of films made is related to the permeability to water vapor being able to appreciate films with more heterogeneous distribution for those who had higher permeability values. The physico-mechanical properties obtained in membranes prepared from agro industry wastes both membranes obtained are comparable to other studies with other biopolymers such as starch. Both agro-industry residues are plentiful in Mexico, so it is important to find applications in the preparation of biomaterials that can be used in various applications such as in food packaging.

References:

Jiju Cherian Vengal and Manu, Srikumar Trends Biomater. Artif. Organs, 2005:18: 237-241.

Danuta M. Napierała, Acta Agrophysica, 2007, 9(1), 123-133.