EVALUATION OF PHYSICAL, MECHANICAL AND BARRIER PROPERTIES OF BIODEGRADABLE FILMS ELABORATED BASED ON-BIOPOLYMERS AND CITRUS WASTE

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Introduction Edible films and coatings have received considerable attention in recent years because of their advantages including use as edible packaging materials over synthetic films. This could contribute to the reduction of environmental pollution. By functioning as barriers, such edible films and coatings can feasibly reduce the complexity and thus improve the recyclability of packaging materials. New materials have been developed and characterized, many from abundant natural sources that have traditionally been regarded as waste materials. In Mexico during 2011, there was a generation of 47,811.35 thousand tons of urban solid waste and the plastics represent 6% of the total (1,3). Mexico is one of the leading producers of citrus (orange) worldwide, with a production of 4,079,677.74 tons4. The waste of these products is rich source of lignin and cellulose, and offers a good source of fiber for different applications (2).
The objective of this study was to develop biodegradable films based on pectin, citrus waste, polyvinyl alcohol (PVA) and glycerol, as well as evaluating the physico-mechanical (Tensile strength and elongation), solubility and water vapor transmission rate.

Methods Five different formulations were elaborated by casting method: F1 to F5 with different concentrations of pectin, citric waste, polyvinyl alcohol and glycerol. The films were storage during 6 months at 25° C and 55±5% RH. The physicochemical properties were followed with a tensile machine (Electronic ®) QC Mod. II-XS, according with ASTM D 882, water vapor permeability was determined using a modified standard method E 96-95 (ASTM 1995). Finally the solubility test in water during 24 hours was followed. The results were analyzed statistically by ANOVA and Tukey Test with SPSS V. 17.0

Results Tensile strength was significantly different between formulations ($p < 0.05$), values ranged between 21.73 and 39.46Nw (F1 and F5, respectively). Elongation percentage varied between 2.83 and 10.76% (F3 and F5, respectively). In tests of water vapor permeability and solubility difference was found between formulations ($p < 0.05$). Values ranged between 1.64×10^{-6} and 3.77×10^{-6} $gH_2O/mm^2/h$ (F5 and F2 respectively) for permeability and 60.78 to 41.69% (F1 and F5, respectively), for solubility. Furthermore in the storage evaluation, the tensile properties, elongation, and water vapor permeability of the films showed significant difference ($p < 0.05$). There was a significant decrease ($p < 0.05$) of tensile strength in F1 and F2 (57% and 43.83%, respectively). The elongation decreased significantly ($p < 0.05$) from 0.16 to 6.80%, in most films except for F3. Water vapor permeability was significantly increased ($p < 0.05$) at 3 months of storage (1.24×10^{-05} and 2.04×10^{-05} $gH_2O/mm^2/h$), remaining stable for the next 6 months

Conclusions Formulation with higher content of polyvinyl alcohol (F5), presented the best properties of tensile strength, elongation, water vapor permeability and solubility. Furthermore, F3 showed the highest stability during storage testing. It was possible to produce edible films using agro-industrial waste generated by industries in the state of Nuevo Leon

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