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Effect of nanoparticles on the release of lactic acid and surfactant from poly (lactic acid)-bionanocomposites

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Poly (lactic acid) PLA is linear aliphatic thermoplastic polyester, in which lactic acid (LA) is the precursor. PLA has become one of the promising biopolymer alternatives to substitute the use of petroleum-based polymers. However, PLA has some limitations such as brittleness, barrier properties, thermal stability, and its susceptibility to hydrolytic degradation under moist conditions. Natural nanoclays as montmorillonite with organomodifiers (OMMT) have been used to enhance PLA performance producing PLA bionanocomposite. Nevertheless, the organomodifiers and/or surfactants could potentially release from the PLA nanocomposites into food systems, where some surfactants have been determined to be toxic to ecosystems and/or humans. Therefore, it is important to evaluate the release of organomodifiers from bionanocomposites to address the safety of PLA-bionanocomposites and to understand the effect of engineered nanoparticles on the hydrolysis of PLA to evaluate the stability of the bionanocomposite. The aims of this work were to study the effect of three different food simulants (water, 50% and 95% ethanol) on the release of the surfactant (a quaternary ammonium compound, QAC) and on the release of LA from PLA bionanocomposites. PLA control (PLA-C), PLA-OMMT (5% wt) and PLA-QAC were produced in a cast film extruder. Release of LA, QAC and change in number-average molecular weight (Mn) of the films were determined using the migration cell recommended by ASTM D4754-11 at 40°C. The results showed that the incorporation of OMMT and QAC in PLA increased the release of LA, with a large change in the release behavior of LA when submerged into 50% and 95% ethanol in the first 50 days. These results were in accordance with the change in Mn where the degradation rate was faster in PLA-OMMT and PLA-QAC films. This study provides a basic understanding of the effect of the OMMT on the hydrolysis of PLA when it is exposed to food simulants and provides the knowledge to develop bionanocomposite containing OMMT in contact with food products.

Biography

Fabiola Iñiguez-Franco is a PhD student at the School of Packaging at Michigan State University. She completed her Bachelor's Degree in Chemical Engineering in 2008 from Universidad de Guadalajara and Master's Degree from Centro de Investigación en Alimentación y Desarrollo in 2011 with a thesis titled "Diffusion studies of catechin and epicatechin from polylactic acid films and physicochemical characterization". She has worked in the food industry in special development projects, as Laboratory Assistant in the Department of Quality Control, and as a sales executive and technical support in food additives. Also, she has been a Lecturer of Food Packaging course in a recognized university in Mexico.

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