

Comparative study of chemical, mechanical, thermal and barrier properties of poly (lactic acid) plasticized with epoxidized soybean oil and epoxidized palm oil

Abstract

To investigate epoxidized palm oil's (EPO) potential as plasticizer for poly (lactic acid) (PLA), its plasticizing effect was compared with commercialized epoxidized soybean oil (ESO). The plasticizers were respectively melt-compounded into PLA at 3, 5, 10, and 15 wt.%. As it was aimed for the blends to be characterized towards packaging appropriate for food products, they were hot-pressed into ~0.3-mm sheets, which is the approximate thickness of clamshell packaging. Fourier transform infrared spectroscopy (FTIR) confirmed the plasticizers' compatibility with PLA. At similar loadings, EPO was superior in reinforcing elongation at break (EAB), thermal, and barrier properties of PLA. The ductility of PLA was notably improved to 50.0% with addition of 3 wt.% of EPO. From thermogravimetric analysis (TGA), PLA/EPO5 improved PLA's thermal stability, while all PLA/ESO blends reported reduced thermal stability. From differential scanning calorimetry (DSC), the increase in crystallinity and the shifts in enthalpy of fusions in all plasticized blends denoted facilitation of PLA to form thermally stable α -form crystals. The addition of EPO enabled PLA to become highly impermeable to oxygen, which can extend its potential in packaging extensive range of oxygen sensitive food.

Keyword: Poly (lactic acid); Epoxidized oil; Plasticizer; Mechanical properties; Thermal properties; Barrier properties