

Revealing the Water Resistance, Thermal and Biodegradation Properties of Citrus aurantifolia Crosslinked Tapioca Starch/Nanocellulose Bionanocomposites

Abstract

Moisture absorption, thermal and biodegradation properties of nanocellulose (NC) reinforced bionanocomposite tapioca starch (TS) films crosslinked with Citrus aurantifolia or lime juice (LJ) were investigated for food packaging applications. The films were synthesized by solvent casting using different amounts of nanocellulose and crosslinkers: lime juice and a commercial citric acid (CA). Nanocellulose as reinforcing filler was obtained from oil palm empty fruit bunches through acid hydrolysis. Crystallinity of all TS bionanocomposites was determined using X-ray diffractometry. TS bionanocomposites interaction with water was studied by means of moisture absorption, moisture content and swelling. Flory-Huggin model was used to measure the crosslinked density of crosslinked TS bionanocomposites which indicated successful crosslinking using LJ and CA for TS. The crystallinity of TS film increased from 43.5% for neat TS to 51.6% for TS film with inclusion of NC. LJ-crosslinked TS film with 1 wt% of NC (based on starch content) had the lowest moisture absorption and swelling ratio. TS bionanocomposites with LJ had better thermal and biodegradation properties compared to commercial CA-crosslinked TS biocomposites, which can be a potential food packaging material among the tested bionanocomposites.

Keywords

Biodegradation properties; Bionanocomposite; Citrus aurantifolia; Crosslinked tapioca starch; Nanocellulose; Oil palm empty fruit bunch