

Properties of Bio composite Film Based on Whey Protein Isolate Filled with Nanocrystalline Cellulose from Pineapple Crown Leaf

ABSTRACT

Among the main bio-based polymer for food packaging materials, whey protein isolate (WPI) is one of the biopolymers that have excellent film-forming properties and are environmentally friendly. This study was performed to analyse the effect of various concentrations of bio-based nanocrystalline cellulose (NCC) extracted from pineapple crown leaf (PCL) on the properties of whey protein isolate (WPI) films using the solution casting technique. Six WPI films were fabricated with different loadings of NCC from 0 to 10 % w/v. The resulting films were characterised based on their mechanical, physical, chemical, and thermal properties. The results show that NCC loadings increased the thickness of the resulting films. The transparency of the films decreased at higher NCC loadings. The moisture content and moisture absorption of the films decreased with the presence of the NCC, being lower at higher NCC loadings. The water solubility of the films decreased from 92.2% for the pure WPI to 65.5% for the one containing 10 % w/v of NCC. The tensile strength of the films peaked at 7% NCC loading with the value of 5.1 MPa. Conversely, the trend of the elongation at break data was the opposite of the tensile strength. Moreover, the addition of NCC produced a slight effect of NCC in FTIR spectra of the WPI films using principal component analysis. NCC loading enhanced the thermal stability of the WPI films, as shown by an increase in the glass transition temperature at higher NCC loadings. Moreover, the morphology of the films turned rougher and more heterogeneous with small particle aggregates in the presence of the NCC. Overall, the addition of NCC enhanced the water barrier and mechanical properties of the WPI films by incorporating the PCL-based NCC as the filler.