

## **Effects of nanocellulose fiber and thymol on mechanical, thermal, and barrier properties of corn starch films**

### **ABSTRACT**

This study explores the preparation of corn starch (CS) films incorporated with nanocellulose fiber (NCF) and different concentrations of thymol (0.1, 0.3, and 0.5% weight of thymol/volume of solution (% w/v)) via the solvent casting method. The resulting films were characterized by the functional chemistry, crystallinity, morphology, mechanical, thermal, and barrier properties. The Fourier transform infrared spectroscopy analysis confirmed the presence of intermolecular hydrogen bonding between the thymol and starch, as well as the thymol and glycerol, via hydroxyl groups of glycerol, starch, and thymol. The film crystallinity decreased with increasing concentration of thymol. The addition of NCF at 1.5% weight of starch increased the tensile strength (TS) and Young's Modulus (YM), but decreased the elongation at break (EAB), oxygen permeability, and water vapor permeability of the CS films. The thermal stability of the CS films was also improved with the addition of NCF. The addition of thymol to the CS/NCF bio-nanocomposite films decreased the TS and YM, respectively but increased the EAB due to the plasticizing effect of thymol. The addition of thymol also improved the thermal stability but reduced the barrier properties of the films. The effects on the mechanical, thermal, and barrier properties were more pronounced at higher concentrations of thymol. In conclusion, the inclusion of both NCF and thymol led to the improvement of the flexibility and thermal stability of the CS films.

**Keyword:** Biopolymer; Corn starch; Film; Nanocellulose; Nanocomposite; Thymol