Preparation and Characterization of Starch based Bionanocomposite Films for Food Packaging Applications

SHORT ABSTRACT

Normal potato starch (PS) was modified with xanthan gum (X) using microwave assisted dry heating (MADH) method at different times such as 0, 4, 8 and 12 min designated as PSX-0, PSX-4, PSX-8 and PSX-12, respectively. The modified potato starches by MADH were compared with conventional dry heating at 130°C for 240 min (PSX-240 min). The results exhibited that modified potato starch with xanthan (PSX-8 min) via MADH showed high peak viscosity, increased apparent viscosity with shear rate, high water holding capacity than other modified potato starches.

Starch sources with different amylose-amylopectin ratios (potato starch, 20:80; wheat starch, 25:75; corn starch, 28:72 and high amylose corn starch, 70:30) are blended with carboxyl methylcellulose (CMC) chitosan (CH) and nanoclay (Na-MMT) to produce bionanocomposite films. Corn starch (CS) allows strong interaction with chitosan and promotes intercalation in to *nanoclay* galleries. The higher crystallinity and molecular miscibility of corn starch with chitosan (–NH, –COOH) and nanoclay (Si-O-Si, Al-OH) were confirmed by XRD. Fourier transform infrared spectroscopy (FTIR) confirmed the shift of amine peak to a higher wavenumber indicating a stronger hydrogen bond between starch and chitosan. Finally, the best bionanocomposite films were tested for food packaging applications. Low density polyethylene (LDPE) exhibited fungal growth on 5^{th} day when packed with bread slices at 25°C and 59% RH whereas corn starch-CH-nanoclay bionanocomposite films did not show the same for at least 20 days when bread samples at 25°C and 59% RH were packed.

The effect of plasticizers (glycerol (GLY)/sorbitol (SOR)) and antifungal agents (potassium sorbate (KS)/grapefruit seed extract (GFSE)) on water barrier, mechanical and thermal properties of corn starch (CS)-chitosan (CH)-nanoclay (Na-MMT) bionanocomposite films. Results showed that CS/CH/nanoclay/SOR/GFSE films exhibit a higher crystallinity than any other bionanocomposite films. Molecular miscibility among corn starch, chitosan (–NH, –COOH) and nanoclay (Si-O-Si, Al-OH) was confirmed by XRD.

The effect of different ratios of grapefruit seed extract (GFSE) on crystallinity, mechanical, water barrier, and thermal properties of bionanocomposite films of corn starch (CS) incorporated with chitosan (CH) and nanoclay (Na-MMT) prepared via solution casting technique. Experimental results showed that GFSE was properly dispersed with corn starch incorporated with chitosan (CH) and nanoclay (Na-MMT) bionanocomposite films. The presence of GFSE up to 1.5% v/v showed higher crystallinity, tensile strength, lower elongation at break, film solubility and water vapor permeability. Furthermore, an addition of GFSE above 2% v/v decreases physical properties of the bio nanocomposite films. Fourier transform infrared spectroscopy (FTIR) analysis revealed that strong hydrogen bonding exists in bionanocomposite films, which is the main reason for interaction among CS, CH, nanoclay and GFSE. The prepared bionanocomposite films could potentially be used for active packaging in order to extend the shelf life, maintain the quality and safety of food products and thus could substitute synthetic plastic packaging materials.