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The Influence of chitosan nanoparticles on the thermal properties of carboxymethylcellulose films

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Abstract – Chitosan nanoparticles were incorporated in carboxymethylcellulose (CMC) matrix followed by processing in the form of nanocomposites films. The films were investigated using thermal analyses, which revealed an increase in the thermo-stability of the films. It was also observed that film solubility significantly decreased upon increasing particle size. Our results are promising as a means to improve final product quality and shelf stability.

Chitosan (CS) is of particular interest in the field of packaging since it is biodegradable, bioabsorbable, and antimicrobial. Cellulose derivatives such as carboxymethylcellulose (CMC) are promising materials for edible coatings or films and nanocomposites applications [1]. However, cellulose films are poor water vapor barriers because of the inherent hydrophilic nature of polysaccharides. The aim of this study is to investigate the effect of addition of CS nanoparticles on the thermal and solubility properties of CMC films. CS nanoparticles were produced by polymerization of methacrylic acid (MAA) in CS solution [2]. The CMC films were prepared using the ratio 2/98 (CMC/water). Chitosan nanoparticles (with sizes of 60, 82 and 110 nm) were added to CMC and placed on a glass surface at room temperature for 24 h. Table 1 shows the water solubility of films with and without nanoparticles. It was found that film solubility significantly decreased upon increasing particle size. For example, the solubility decreased to 97.0; 97.3 and 92.3 % for films with 60, 82 and 110 nm of CS-PMAA nanoparticles, respectively. Potential applications may require packaging with minor water solubility to enhance product integrity and water resistance. The Td (temperature of degradation) of films is also very important. In films that contain only CMC, the Td is 280 ºC. The addition of nanoparticles into the films increases the Td to 289, 291 and 298 ºC for films with nanoparticles of 60, 82 and 110 nm, respectively. The thermal degradation temperature was increased in films containing nanoparticles. These findings indicate that use of nanotechnology can improve functionality of edible and/or packaging films for food applications.

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Table 1: Solubility of different films made from solution casting.

Material	Particle Size (nm)	Solubility (%)
CMC film	No nanoparticle	100
CMC film + nanoparticle	60	97.0 ± 1.1
CMC film + nanoparticle	82	97.3 ± 1.0
CMC film + nanoparticle	110	92.3 ± 1.0

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