Characterization of thermal and water vapor barrier properties in HPMC edible films content chitosan nanoparticles

M. R. de Moura[1,4], R. J. Avena-Bustillos[2], T. H. McHugh[2], J. M. Krochta[3], L. H. C. Mattoso[4]

[1]Chemistry Dept. – UFSCar, São Carlos, São Paulo, Brazil
[2]Agricultural Research Service, WRRC, Albany, California, United States
[3]Dept. of Food Science and Technology, UCDavis, California, United States
[4]National Nanotechnology Laboratory for Agriculture, Embrapa-Cnpdia, São Carlos, São Paulo, Brazil

For the past 10 years, many research programs have focused on developing more and more sophisticated edible films and coatings [1]. Among them, polysaccharide polymers such as hydroxypropyl methylcellulose (HPMC) and chitosan have been particularly studied. Cellulose derivatives such as HPMC are promising materials for edible coatings or films. However, cellulose films are poor water vapor barriers (WVP) because of the inherent hydrophilic nature of polysaccharides [2]. Chitosan (CS) is of interest in the packaging field since it is biodegradable, bioabsorbable, and antimicrobial agent [3]. The aim of the present work is to study the effect of addition of nanoparticles made using CS and sodium tripolyphosphate (TPP) on the thermal and water vapor permeability properties of HPMC films. The CS–TPP nanoparticles were obtained according to the procedure based on the ionic gelation of CS with TPP anions. The HPMC film was prepared using the ratio 3/97 (HPMC/water). The chitosan particles in suspension (in three different sizes) and HPMC were mixed to the preparation of films. After the solutions prepared were placed on a glass surface at room temperature and let dry for 24 h. The particles have been studied by particle sizes and the films by water vapor permeability (WVP) and thermal analysis. The WVP of the control HPMC film was 0.79 g mm kPa^{-1} h^{-1} m^{-2}.The WVP decreased significantly when nanoparticles were incorporated to HPMC films due to decreases in diffusion of water between surfaces of the film. For example, WVP decreased to 0.58, 0.45 and 0.33 g mm kPa^{-1} h^{-1} m^{-2} for films containing nanoparticles with 220, 110 and 85 nm, respectively. The Td (temperature of degradation) of films is also very important. In films that contain only HPMC, the Td is 232 ºC. The addition of nanoparticles into the films increases the Td to 276, 271 and 279 ºC for films with CS-TPP nanoparticles of 220, 110 and 85 nm, respectively. The thermal degradation temperature was increased in films containing nanoparticles. This fact is important because the presence of nanoparticles in the films improved the thermo-stability of the films. These findings indicate that use of nanotechnology can improve functionality to edible films for food applications.

Keywords: Chitosan nanoparticles, sodium tripolyphosphate, WVP, edible films.

Work supported by CNPq (Processes MRM 141694/2005-0 and PQ 307.935/2004-3), Embrapa Brazil (Labex Program), FINEP/LNNA and USDA, ARS, WRRC.

[1] N. Dogan, T. H. McHugh, J. Food Sci. **72**, 16 (2007).
[2] I. Sebti, E. Chollet, P. Degraeve, C. Noel, E. Peyrol, J. Agric. Food Chem. **55**, 693 (2007).
[3] M. R. de Moura, F. A. Aouada, L.H.C. Mattoso, J. Colloid Interface Sci. **321**, 477 (2008).
Márcia Regina de Moura - mregina@cnpdia.embrapa.br: Rua XV de Novembro, 1452 São Carlos, SP - Brasil - CEP 13560-970.