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Preparation of biocompatible films from aqueous dispersions of zein nanoparticles

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Excessive food waste makes a global agri-food production highly inefficient. One of the ways to minimize food loss and waste and to promote sustainability of agri-food systems is through advanced food packaging. Zein, a biodegradable, edible corn protein, has been increasingly investigated for its applications as food coating and packaging material. Since zein displays hydrophobic properties and insolubility in water, its coatings are usually prepared from aqueous ethanol solutions. Due to toxicological, ecological and manufacturing safety concerns with organic solvents, there has been an increased need to develop aqueous-based coating systems.

In this work, a stable aqueous zein dispersion i.e. zein pseudolatex (latex - colloidal dispersion of polymer particles in a liquid) was prepared by spontaneous antisolvent precipitation of 10% w/w zein solution in 90% v/v aqueous ethanol. The prepared dispersion was concentrated in a rotary evaporator to a concentration of 4%. The method used for film preparation was by casting the zein dispersions in polystyrene dishes and vacuum-drying them at 60°C. During the film formation process several steps took place including water loss, deformation and coalescence of nanoparticles, resulting in homogenous film. Zein films prepared without a plasticizer are brittle, therefore zein films were plasticized with either propylene glycol (PG), glycerol (GLY), polyethylene glycol 200 (PEG 200) or polyethylene glycol 600 (PEG 600). Plasticizer was added at 30% w/w based on zein weight. Zein films were conditioned at 20°C and 65% relative humidity for three days before characterization.

It was found that stable aqueous dispersions of zein nanoparticles of around 130 nm in diameter can be prepared using antisolvent precipitation, and that continuous films can be obtained from this aqueous system. Obtained films absorbed different amounts of water depending on the type of plasticizer, which resulted in different mechanical properties and water susceptibility of the films.

Keywords: zein, pseudolatex, biocompatible films