Polymer Assisted Housing of Actives for Designed Release

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ABSTRACT

Controlled release is a term referring to the presentation or delivery of active ingredients in response to time or stimuli (such as pH, enzymes, light, magnetic fields, temperature, ultrasonic, osmosis, electronic control, etc.) at a desired site. The control (or more appropriately designed or defined) release of actives can be achieved via encapsulation-immobilization of the same. This talk will focus on our work in the area of encapsulation - immobilization of a flavor ingredient by a variety of techniques including controlled polymerization, coacervation, cocrystallization-complexation, capsules, emulsification, inclusion complexation, porous materials, supercritical CO2 assisted impregnation, etc. for controlled release applications. As an example the atom transfer radical polymerization of methyl acrylate was performed in a controlled/living manner. The pyrolysis of poly-(methyl acrylate) released flavor compounds and provided an alternative route to synthesize poly (acrylic acid) with controlled structures. In another approach we had prepared porous structures using hot melt reactive extrusion blending of chitosan (up to ~40%) and poly (acrylic acid) PAA without any process additives. The carboxylic groups of PAA interacted with the amine groups of chitosan during the melt process, and the system exhibited good melt flow. The infrared spectroscopic data confirmed the existence of a complex formation and possible hydrogen bonding between chitosan and PAA during the melt process. Scanning electron microscopy micrographs indicated that chitosan was well-dispersed in the PAA blends. Similarly we had prepared porous fibers using a novel polymer blend comprising a hydrophobic poly(vinyl acetate) (PVAC) and a hydrophilic poly(acrylic acid) (PAA) in a single step by melt spinning process. The fibers melt-spun from the polymer blends of 40 - 60% PVAC with PAA making the remainder of 100% consisted of a honeycombed, porous fiber structure with some internal cell to cell interconnectivity. These porous structures are capable of housing active ingredients for later use. As a different technique we had used near-critical and supercritical CO2 to facilitate the impregnation of flavors such as, vanillin and l-menthol, into cellulose acetate (up to ~10 wt% vanillin or l-menthol impregnated into CA fiber as verified by gravimetric, TGA, and TGA/MS analyses). SEM analysis of the CA fiber showed that the fiber did not undergo structural changes for this impregnation process. These studies will be further elaborated during this talk.

1. M. Mishra (Ed); Handbook of Encapsulation Controlled Release; 2015, CRC Press, Boca Raton, USA