ENCAPSULATION OF AQUEOUS-CORE NANOCAPSULES IN PLLA MULTICOMPARTMENTS MICROPARTICLES

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Microporous membrane emulsification technique can generate monodisperse droplets that can be further polymerized or solidified, resulting in a very narrow particle size distribution. In this work, monodisperse multicompartment particles as platform for controlled delivery systems based on nanoparticles subunits were obtained. Experiments were performed in order to encapsulate cross-linked starch nanocapsules in poly(lactic acid) (PLLA) microparticles. The design of the multicompartment system aims the encapsulation of a hydrophilic compound in the nanocapsules and a hydrophobic one in the PLLA matrix, thus allowing the simultaneous encapsulation of hydrophilic and hydrophobic compounds. For that, the subunits were composed of aqueous-core cross-linked starch nanocapsules with controlled permeability prepared using inverse miniemulsion technique. PLLA microparticles with narrow size distribution containing cross-linked starch nanocapsules were obtained with SPG membrane emulsification followed by solvent evaporation techniques.

Results showed that the average particle size decreased by decreasing the pore diameter of SPG membrane, maintaining a constant ratio between mean particle size and mean pore size. It was also noted that the mean pore size of the membrane plays an important role that can affect the encapsulation efficiency of nanocapsules in microparticles. When the membrane with the smaller pore size was used (2 μm) the nanocapsules were not incorporated in the PLLA microparticles, but probably remained retained in the pores of this membrane since both, membrane and nanocapsules, have a hydrophilic character and the pores are relatively small compared to the size of the NCs (200 nm).

Furthermore, based on SEM and CLSM analyses, it was verified that the nanocapsules location in the microparticles can be modulated to a certain extent by the conditions used during solvent evaporation and that the surface modification of cross-linked starch NCs with grafted NCO-terminated-PLLA oligomers results in a more homogeneous distribution of the NCs inside the PLLA microparticles. In terms of application, the location of the NCs containing encapsulated hydrophilic compounds in the microparticles (close to their surface or homogeneously distributed) will define the release rate of the payload.

Finaly, it was shown that the assembly of monodisperse multicompartment particles allows simultaneous encapsulation of hydrophilic and hydrophobic compounds and that the polymers chosen presented selective enzymatic degradation. Thus, these results indicate the potential of the developed platform as drug delivery system with enzyme-triggered release.