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Abstract

High-Capacity $CaCO_3$ Containers: The Effect of Size on Drug Loading and Interaction with Cells †

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Abstract: A series of calcium carbonate particles with sizes of 500 ± 80 and 200 ± 90 nm were obtained using mass crystallization in aqueous salt solutions by varying the reaction conditions and adding glycerol or a combination of polyethylene glycol, polysorbat-80 and cell cultural medium to the reaction volume. Calcium carbonate nanoparticles of 50 ± 30 nm in diameter were synthesized within the pores of mesoporous silica particles with a subsequent etching out of the template material. A complete characterization of the particles was carried out using scanning and transmission electron microscopy, X-ray powder diffraction, and dynamic and electrophoretic light scattering. $CaCO_3$ particles were loaded with anticancer drugs, porphyrazine and doxorubicin, with an encapsulation efficiency of 2–5 and 4–11 wt.%, respectively. The spontaneous release at pH 7 reached 15%, and when the particles are dissolved at pH 4, the release was about 45% of the substance during the day, regardless of the encapsulated substance. Functionalization of the surface of calcium carbonate particles with a biocompatible Pluronic-folic acid conjugate did not affect the particle size distribution and aggregative stability for all three samples. The effect of coatings on the rate of internalization and accumulation of particles by cells expressing folic acid receptors was established. It was also shown that the internalization of 50 ± 30 nm particles was more active than other samples.

Keywords: calcium carbonate nanoparticles; high-capacity containers; porphyrazine; doxorubicin; targeted drug delivery

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