Synthesis and characterization of CaCO3–biopolymer hybrid nanoporous microparticles for controlled release of doxorubicin

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Résumé en anglais	Doxorubicin (Dox) is a hydrophilic drug extensively used for treatment of breast, lung, and ovarian cancer, among others; it is highly toxic and can cause serious side effects on nontargeted tissues. We developed and studied a hybrid nanoporous microparticle (hNP) carrier based on calcium carbonate and biopolymers derivatized with folic acid (FA) and containing Dox as a chemotherapeutic drug model. The hNPs were characterized by X-ray diffraction, and Raman and Fourier transform infrared (FTIR) spectroscopies. The X-ray diffraction patterns of calcium carbonate particles showed about 30–70% vaterite–calcite polymorphisms and up to 95% vaterite, depending on the absence or the presence of biopolymers as well as their type. Scanning electron microcopy images revealed that all types of hNPs were approximately spherical and porous with average diameter 1–5 μm, and smaller than CaCO3 microparticles. The presence of biopolymers in the matrices was confirmed after derivatization with a fluorescein isothiocyanate probe by means of confocal microscopy and FTIR synchrotron beamline analysis. In addition, the coupling of lambda carrageenan (λ-Car) to FA in the microparticles (FA–λ-Car-hNPs) increased the cancer-cell targeting and also extended the specific surface area by up to ninefold (26.6 m2 g−1), as determined by the Brunauer–Emmett–Teller isotherm. A nanostructured porous surface was found in all instances, and the FA–λ-Car-hNP pore size was about 30 nm, as calculated by means of the Barrett–Joyner–Halenda adsorption average. The test of FA–λ-Car-hNP anticancer activity on human osteosarcoma MG-63 cell line showed cell viabilities of 13% and 100% with and without Dox, respectively, as determined by crystal violet staining after 24 h of incubation.

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