Fabrication of Lipid-Coated Chitosan Nanoparticles

Sheryhan F. Gad, Gihan N. Fetih, Sozan S. Tous and Giovanni M. Pauletti

Abstract:

Aims: Conventional chitosan nanoparticles (CSNPs) exhibit high encapsulation efficiency for hydrophilic drugs but lack substantial payload capacity for lipophilic drugs. This study explores fabrication of a novel lipid/chitosan nanocomposite suitable for combination therapy using hydrophilic and lipophilic drugs. Methodology: Lipid coating of prefabricated CSNPs that were prepared by ionotropic gelation with tripolyphosphate (TPP) was accomplished in 0.1 M acetate buffer, pH 5.3, using an equimolar mixture of 1, 2-dipalmitoyl-sn-glycero-3-phosphocholine (DPPC) and L-α-dipalmitoylphosphatidyl glycerol (DPPG) or DPPC only. Dynamic laser light scattering (DLS) was used to monitor particle size distribution and zeta potential. Results: Rapid addition of TPP to chitosan (CS) solution prepared in acetate buffer at a final TPP/CS = 0.3:1 (g/g) reproducibly resulted in CSNPs with a mean hydrodynamic diameter of 82.8±1.7 nm and a zeta potential of +20.5±1.2 mV. Hydration of dried phospholipid films using this CSNP suspension progressively increased mean particle size of colloids up to 613.5±13 nm depending on lipid composition and lipid concentration applied. Zeta potential of DPPC/CS nanocomposites was significantly reduced to +8.7±0.1 mV, whereas surface charge of (DPPC/DPPG, 50:50)/CS nanocomposites remained unchanged between +18.8 and +21.6 mV, respectively. Conclusion: Physicochemical assessment of lipid/CS nanocomposites prepared by thin film hydration suggests successful surface immobilization of zwitterionic DPPC on prefabricated CSNPs. The presence of this additional lipid layer surrounding the hydrophilic CS core is predicted to facilitate effective encapsulation of lipophilic drugs enabling combination therapy with hydrophilic and hydrophobic payloads using a single nanodelivery system.

Keywords:

Ionotropic gelation; thin film hydration; phospholipids; nanocomposites

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