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Polylactide-based Magnetic Spheres as Efficient Carriers for Anticancer Drug Delivery

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Abstract

To improve traditional cancer therapies, we synthesized polylactide (PLA) spheres coencapsulating magnetic nanoparticles (MNPs, Fe(sub3)O(sub4)) and an anticancer drug (doxorubicin, DOX). The synthesis process involves the preparation of Fe(sub3)O(sub4) NPs by a coprecipitation method and then PLA/DOX/Fe(sub3)O(sub4) spheres using the solvent evaporation (oil-in-water) technique. The Fe(sub3)O(sub4) NPs were coated with oleic acid to improve their hydrophobicity and biocompatibility for medical applications. The structure, morphology and properties of the MNPs and PLA/DOX/Fe(sub3)O(sub4) spheres were studied using various techniques, such as FTIR, SEM, TEM, TGA, VSM, UV-vis spectroscopy, and zeta potential measurements. The in vitro DOX release from the spheres was prolonged, sustained, and pH-dependent and fit a zero-order kinetics model and an anomalous mechanism. Interestingly, the spheres did not show a DOX burst effect, ensuring the minimal exposure of the healthy cells and an increased drug payload at the tumor site. The pronounced biocompatibility of the PLA/DOX/Fe(sub3)O(sub4) spheres with HeLa cells was proven by a WST assay. In summary, the synthesized PLA/DOX/Fe(sub3)O(sub4) spheres have the potential for magnetic targeting of tumor cells to transform conventional methods.