Synthesis and characterization of a novel biocompatible pseudo-hexagonal NaCa-layered double metal hydroxides for smart pH-responsive drug release of dacarbazine and enhanced anticanceractivity in malignant melanoma

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Abstract

Layered metal hydroxides have exhibited remarkable benefits in drug delivery, days or even weeks ofcontinuous drug release with improved bioavailability and minimized adverse effects. Here, we report synthesis of a new M+ (Na+) and M2+ (Ca2+) layered double metal hydroxide-based phases with the general formula of [Na0.2Ca0.8(OH)(1.4)] (NO3)(0.4), and 3D pseudo-hexagonal morphology. NaCa layereddouble metal hydroxide (NaCa-LDH), which is biodegradable, biocompatible, and pH-sensitive, could have broad applicability in drug release and other biomedical applications. Dacarbazine (DAC) is one ofthe most commonly used chemotherapy drugs for treating various cancers. However, its poor water solubility, short half-life in blood circulation, low response rate and high side effects limit its application. This study aimed to increase its half-life and anticancer activity; minimize its side effects; and prolong its drug release by intercalating of DAC in biodegradable NaCa-LDH (DAC-LDH). Results from the intercalation process show that NaCa-LDH is able to intercalate DAC with a simple procedure and with a good drugloading (38% w/w) through a one pot reaction. The DAC shows a sustained and pH-sensitive release, and the release rate of DAC from DAC-LDH at pH 7.4 is remarkably lower than that at pH 6.0 due to its different release mechanisms. In the latter case, the release was not complete at 24 h. We show that DAC-LDH anticancer efficacy on malignant (A-375) melanoma and breast cancer (MCF-7) cell lines is higher than that of free DAC. These nanoparticles may open a significant way toward the development of a pH-sensitive drug release system that minimizes drug side effect for a wide range of applications.

Keywords

Author Keywords: Breast cancer; Dacarbazine; Drug delivery; Layered double metal hydroxide; Malignantmelanoma; pH sensitive