Preparation and controlled-release studies of a protocatechuic acid-magnesium/aluminum-layered double hydroxide nanocomposite.

ABSTRACT

In the study reported here, magnesium/aluminum (Mg/Al)-layered double hydroxide (LDH) was intercalated with an anticancer drug, protocatechuic acid, using ion-exchange and direct coprecipitation methods, with the resultant products labeled according to the method used to produce them: "PANE" (ie, protocatechuic acid-Mg/Al nanocomposite synthesized using the ion-exchange method) and "PAND" (ie, protocatechuic acid-Mg/Al nanocomposite synthesized using the direct method), respectively. Powder X-ray diffraction and Fourier transform infrared spectroscopy confirmed the intercalation of protocatechuic acid into the inter-galleries of Mg/Al-LDH. The protocatechuic acid between the interlayers of PANE and PAND was found to be a monolayer, with an angle from the z-axis of 8° for PANE and 15° for PAND. Thermogravimetric and differential thermogravimetric analysis results revealed that the thermal stability of protocatechuic acid was markedly enhanced upon intercalation. The loading of protocatechuic acid in PANE and PAND was estimated to be about 24.5% and 27.5% (w/w), respectively. The in vitro release study of protocatechuic acid from PANE and PAND in phosphate-buffered saline at pH 7.4, 5.3, and 4.8 revealed that the nanocomposites had a sustained release property. After 72 hours incubation of PANE and PAND with MCF-7 human breast cancer and HeLa human cervical cancer cell lines, it was found that the nanocomposites had suppressed the growth of these cancer cells, with a half maximal inhibitory concentration of 35.6 μg/mL for PANE and 36.0 μg/mL for PAND for MCF-7 cells, and 19.8 μg/mL for PANE and 30.3 μg/mL for PAND for HeLa cells. No half maximal inhibitory concentration for either nanocomposite was found for 3T3 cells.

Keyword: 3T3; Direct coprecipitation method; HeLa; Ion-exchange method; MCF-7; Mg/Al-LDH.