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A facile greener approach to synthesize curcuminoids incorporated layered double hydroxides

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Natural plant-based compounds are increasingly gaining scientific attention as preventive medicine and efficient active ingredients in pharmaceuticals. Among the pharmacopeia of traditional medicines, curcuminoids derived from *Curcuma longa* are at high priority due to its superior antioxidant and antibacterial activities. However, utilization of curcuminoids is limited due to its poor bioavailability and photo-stability. This study focuses on the stabilization of curcuminoids derived from a natural extract of *Curcuma longa* between the layers of layered double hydroxides (LDHs) using a simple and green mechanochemical grinding approach. This facile synthetic approach offers many advantages over the traditional co-precipitation method. Structural and morphological characterization of the synthesized curcuminoids incorporated Layered Double Hydroxides (Cur-LDHs) composites were evaluated. The nanosized hydrotalcite-like layered morphology of Cur-LDHs was confirmed by transmission electron microscopy imaging. Successful incorporation of curcuminoids into LDHs was confirmed using powder X-ray diffractogram. There was a significant peak shift in the *(003)* diffraction peak of nitrate-LDHs from 8.90 Å to 7.66 Å. Moreover, Fourier transform infra-red spectroscopy evidence confirmed the weak electrostatic interactions between the curcuminoids and LDHs. The successful incorporation of curcuminoids into LDHs was further attested by the X-ray photoelectron spectroscopic analysis. It clearly depicts the electron density variations that arise in Mg^{2+} and Al^{3+} ions in the presence of curcuminoids between layers of LDHs. Interestingly, Cur-LDHs obtained from mechanochemical grinding methods have a higher thermal stability compared to isolated curcuminoids due to formation of the strong hydrogen bonding and electrostatic interactions between curcuminoids and LDHs. The decomposition temperature of curcuminoids has been increased from 375 °C to 412 °C by confirming the thermal stabilization of curcuminoids in the LDH matrix. The release behavior of incorporated curcuminoids were tested at pH 5.5 buffer solution and data fitted into the zeroth order kinetics by suggesting that the release mechanism is based on the curcuminoid dissolution without forming aggregations. The release profile exhibits slow and sustained release of curcuminoids from LDHs. Thus, we can assert the aptitude of Cur-LDHs as an advanced biomaterial which would be advantageous in pharmaceutical/cosmeceutical applications.

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