pH Tunable Curcumin Release from PMMA-AA Coated ZnO Nanoparticles for Excellent Anti-Gastric Cancer Therapy

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Abstract

PMMA-AA encapsulated ZnO bionanoconjugate (Cur/PMMA-AA/ZnO) was successfully synthesised and utilized as good cargo materials to carry the well-known hydrophobic drug curcumin by surface functionalization. Physical characteristics of this novel bioconjugate has been studied with transmission electron microscopy (TEM) and powder X-ray diffraction (XRD) in conjunction with spectral techniques. A narrow particle size distribution with an average value of 42 nm was found via TEM. Most importantly, the pH-responsive curcumin release from this nano-vehicle ensures safer, much controlled delivery towards gastric cancer cell lines at physiological pH gradients. The efficient curcumin entrapment and loading were evaluated along with its in vitro efficacy with mice model, which showed a potent inhibition on the growth of AGS cancer tumour in male Swiss albino mouse, and acts as a promising targeted cancer agent. Interestingly the given bio-nanocomposite was rapidly cleared from the organs with negligible exhibition of toxicity. From the obtained results it is understood that the apoptosis has been occurred through mitochondrial disruption-mediated pathway. Also these nanomaterials could efficiently hinder the Go/G1 transition along with cycle progression at S-phase transition due to the radiation-induced DNA damage. These findings declared that the auspicious candidate, curcumin could be successfully delivered into the specific target by the polymer encapsulated ZnO NPs and exhibited a potent activity against gastric cancer cells at molecular and cellular levels as well as cell proliferation in a panel of tumour cells. The multifunctional properties of the studied bionanoconjugate system may open up new avenues in cancer therapy through overcoming the limitations of conventional cancer therapy.