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Folic acid-conjugated chitosan-based quantum dot system for cancer cell imaging and therapy

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Current research in targeted delivery through engineered nanocarries has demonstrated a promising mild stone in achieving specialized and personalized medicine following the exploitation of biomolecules uniquely expressed by cancer cells to conveniently transport therapeutics with improved efficiency and limited systemic toxicity. Here, we report the synthesis of a nanocomposite, semiconductor Quantum Dots (QDs) system following simple wets chemistry method for cancer theranostic applications. The chemistry involves the loading of an anti-cancer drug (5-Fluororacil) into Mn-ZnS QDs encapsulated Chitosan (CS) biopolymer with Folic Acid (FA) conjugation. The binding of the QDs to FA conjugated CS was confirmed using XPS, FTIR and EDX analysis and the elemental mapping of the drug loaded nanocomposites was characterized using FTIR and DSC analysis. The cytotoxicity analysis performed on breast cancer cells (MCF-7 and MDA cell lines) and normal breast cell lines (MCF-10) shows the effectiveness of the sample towards the destruction of cancer cells and its non-toxicity towards normal cells. The mechanistic study by means of flow cytometry revealed that the drug loaded conjugates has high selectivity towards the destruction of cancer cells than bare anti-cancer drug. The results demonstrated that the decoration of FA on the drug loaded conjugates owing to its stronger affinity toward folate receptors largely expressed by cancerous cells enhances the level of drug uptake by the cells and the QDs incorporated into the system allowed selective imaging of the cancer cells under confocal microscopy. The results highlight the suitability of FA-conjugated Mn-ZnS QDs as promising probe for cancer theranostic.

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