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Abstract

Biocompatible Bifunctional Anti-EGFR DNA-Aptamer Targeted Chitosan Coated Iron-oxide Nanocomposite Containing Noscapine for Cancer Cell Theranostic

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Abstract

Background and Aim: This study focuses on addressing these challenges by developing novel carboxyl modified (C) and single-strand DNA-aptamer (Apt) functionalized Chitosan (CS) nanoparticles. The objective is to achieve targeted delivery of noscapine (NO) and Fe3O4 nanoparticles to MCF-7 breast cancer cells.

Method: The synthesis of Apt-C-CS-NO-Fe3O4 nanocomposites was conducted, and their characterization involved the use of analytical techniques such as FT-IR, DLS, and TEM to qualify and quantify the nanocomposites. The size range of the nanocomposites was determined to be between 15 nm to 50 nm in diameter. Biomedical tests, including cell viability, cell uptake iron content, relaxivity of iron oxide nanoparticles, and in vitro MRI, were employed to evaluate the diagnostic and therapeutic performance of the nanocomposites.

Results: The MTT test results revealed cell viability ranging from 75% to 100% for C-CS, Apt-C-CS, and Apt-C-CS-Fe3O4 samples after 24 h and 48 h of treatment with 5 µg/mL and 10 µg/mL, while it ranged from 65% to 70% for NO-containing nanocomposite. The iron content in cancer cells treated with Apt-C-CS-NO-Fe3O4 and Apt-C-CS-Fe3O4 was approximately two times higher than that of the C-CS-Fe3O4 sample. Relaxivity tests (R2 relaxation) showed a negative slope for pure Fe3O4, while it was positive for Apt-C-CS-Fe3O4 and C-CS-Fe3O4 nanocomposites. In vitro MRI indicated excellent contrast for Apt-C-CS-NO-Fe3O4 nanocomposites, reinforcing the significance of targeted drug delivery.

Conclusion: The study created Apt-C-CS-NO-Fe3O4 nanocomposites for targeted breast cancer cell delivery, showing promising diagnostic and therapeutic potential through comprehensive characterization and biomedical tests.

Keywords: *Chitosan nanoparticles, DNA-aptamer, Iron oxide nanoparticles, Cancer cell detection and inhibition, Magnetic resonance imaging (MRI)*

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