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Synthesis of Superparamagnetic Iron Oxide Nanoparticle (SPIONs) for Drug Delivery and X-ray Imaging †

Justin C. [1], Durgasruthi P. [2,*]

[1] Department of Biotechnology, School of Bio and Chemical Engineering, Sathyabama Institute of Science and Technology, Sholinganallur, Rajiv Gandhi Salai, Chennai, Tamil Nadu, 600 119, India
[2] Faculty of Science, KU Leuven, Leuven 3000, Belgium
* Correspondence: durgasruthi@gmail.com;
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Abstract: Precursor iron molecular solution for the synthesis of SPIONs was optimized for the production of superparamagnetic iron oxide nanoparticles (SPIONs). Thus produced SPIONs were subjected for core-shell – SPIONs synthesis for drug delivery, which had the following four major stages (1) synthesis of SPIONs, (2) functionalization of SPIONs, (3) curcumin loading, and (4) biopolymer coating (Chitosan). Every stage of the synthesis was analyzed using various microscopic (TEM, SEM, AFM) and spectroscopic (UV Vis, FTIR, Zeta Analyzer, Raman Spectroscopy, GIXRD, PXRD, XPS, SQUID, VSM) analysis. Through spectroscopic techniques, mainly the elemental nature and the energy states of elements present all through the core-shell production were studied. The core-shells were subjected to drug delivery studies against HCT 116 and HeLa cells. Core-shell SPIONs were showing IC50 at 30µg and 80µg concentration against HeLa and HCT 116 cell lines, respectively. IC50 concentration was subjected for further anticancer studies through nuclear staining, flow cytometry, and expression of caspase 3 at four-time duration: 2 hours, 6 hours, 12 hours, and 24 hours. The core-shell SPIONs were found to induce cancer apoptosis, which was analyzed using quadrant and histogram statistics obtained as per flow-cytometer. Caspase 3 expression was analyzed using a caspase expression assay. Further, they were evaluated by histogram statistics. SPIONs were utilized as a contrasting agent for X-ray imaging, where it was showing the egg visibility. The response of SPIONs to X-ray was studied with and without the applied magnetic field. Later, the SPIONs were subjected to toxicity study against earthworm.

Keywords: SPIONs; Core-shell-SPIONs; Precursor iron molecular solution; Stabilization; Functionalization; Microscopy; Spectroscopy; Core shell production.

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Conflicts of Interest

The authors declare no conflict of interest.