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Development of an efficient drug delivery nanosystem to tumor cells

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Mesoporous Silica Nanoparticles (MSNs) have been considered as promising drug delivery systems, namely for carrying anticancer drugs, in order to improve the efficacy of conventional chemotherapy treatments. In this work, we developed a novel and effective redox and pH-responsive drug delivery system, based on MSNs, to address hepatocellular carcinoma (HCC) cells. To this intent, tetrasulfide-based MSNs (TMSNs) were developed and functionalized with (3-aminopropyl) triethoxysilane (APTES) (TMSNs-NH₂).

The obtained TMSNs had a mean diameter of 165 ± 21 nm, with a surface area of 745 m²/g and an average pore diameter of 2.3 nm. The presence and homogeneous distribution of sulfur throughout the TMSNs framework were confirmed through Scanning Transmission Electron Microscopy coupled with Energy-dispersive X-ray Spectroscopy (STEM-EDS), as well as CHNS elemental analysis, which revealed that about 32 mol% of BTESPT was integrated into the nanoparticle structure.

TMSNs were successfully functionalized with amine groups using an eco-friendly post-synthetic grafting process. The success of the APTES grafting process was confirmed through a zeta potential analysis, as well as the analysis of nitrogen adsorption-desorption isotherms of TMSNs-NH₂, which revealed a decrease in surface area and pore volume when compared with unfunctionalized TMSNs. In addition, the developed nanosystems were evaluated as anticancer drug delivery systems, using Epirubicin (Epi) as a model drug to study their drug loading and release profiles, which confirmed their responsive release. Finally, the cytotoxicity of the nanosystems in HepG2 cell line was assessed by Alamar Blue assay and the results revealed promising drug release effectiveness.

Biography

Henrique Faneca is principal investigator at Centre for Neuroscience and Cell Biology, and invited assistant professor at University of Coimbra. He received is PhD degree in Biochemistry from Coimbra University in 2005. The main focus of his research are the development of lipid- and polymer-based nanosystems for gene and drug delivery into target cells and the generation of new antitumor strategies, involving different gene therapy approaches either per se or in combination with chemotherapeutic agents. Henrique Faneca is author of more than 45 scientific papers corresponding to over 1500 citations and to an h-index of 19.

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