Synthesis and characterization of Bi@DX nanoparticles for biomedical applications

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Studies involving gold, iron and hafnium nanoparticles have proved the effectiveness of the use of high-Z NPs as sensitizers in radiotherapy of different cancers.[1] Recently, bismuth nanoparticles (BiNPs) have also been considered for this purpose.[2] Therefore, it is justified to investigate synthesis routes of BiNPs for the control of size, shape and physico-chemical/stability properties. One of the strategies to guarantee the stability of BiNPs is the addition of a biocompatible compounds that can act as a coating, such as polymers, sugars, or proteins. In this work, the synthesis and characterization of BiNPs coated with the polysaccharide dextran (Bi@DX) was investigated aiming their use as a radiosensitizer NPs for glioblastoma, a malignant tumour that affect the central nervous system. The Bi@DX were prepared *in-situ* by chemical route, in aqueous solutions, according to the protocol adapted from Brown (2012).[3] Briefly, in a reactor 20 mM of bismuth nitrate was mixed with 2 M of glycine and heated at 80 °C, in constant magnetic stirring. The pH of the solution was adjusted with potassium hydroxide up to 10, followed by the addition of 1 mM dextran (Mw= 10k Da) and 275 mM of sodium borohydride. The solution gradually turned to black and the reaction was kept for more 25 minutes, until at 80 °C and stirring. The pH was readjusted to 7.5, and kept at heating and stirring for more 60 minutes. The final solution was purified by dialysis (M_{WCO}14 kDa), and then lyophilized. To control the BiNPs size, experiments were conducted with different DX concentrations (0.5mM and 2mM) and temperatures (40 °C and 0 °C), and characterized according to their size, morphology, functional chemical groups, and colloidal stability. The Bi@DX had predominantly a spherical shape and core diameter around 4.4 ± 1.2 nm. The meansize in aqueous solution was 274.0 ±68.4 nm with a zeta potential of -5.9 ± 0.5 mV. The infrared analysis showed absorption bands characteristic of Bi and polysaccharides. The resulting UV-VIS spectrum showed the characteristic absorption bands for Bi at 541 nm. We are currently evaluating the cytotoxicity of the Bi@DX (80 °C) NPs and DNA damage in cells incubated with NPs and irradiated with X-rays from a 6 MV linear accelerator.

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