ABSTRACT

In this thesis, we studied hyperthermia response of nanostructured iron oxides due to their potential applications in biomedicine. Some biomedical applications include magnetic hyperthermia for cancer treatment, NMR imaging, drug delivery, tissue engineering and cell separation. In this work we synthesized iron oxide nanoparticles, γ-Fe_2O_3 and Fe_3O_4, and used them separately or in combination, with the aim to induce hyperthermia in cancer cells. Two samples were selected over a series of 12 samples, based on their size (10-12 nm), their high hyperthermia response ($\Delta\theta$ > 20-30 ^oC), their magnetic properties (M_s = 65 emu/g) and the fact that they ehxibit superparamagnetic features at room temperature. The magnetic nanoparticles (MNPs) were added to cell cultures, e.g. the cervical cancer cell line HeLa and the mammary adenocarcinoma cell lines DA3 and MCF-7. An initial concentration of 2 mg/ml of MNPs was added to 10.000-50.000 of cells (leading to a final concentration of MNPs 0.5 mg/ml within cell sample) and left over a period of 24 h and 48 h for cellular uptake. Administration of MNPs to the tumor cells resulted in a very good absorbance/uptake by these cells and in high viability (more than 90%), pointing to the fact that the produced MNPs are not toxic. Proliferation and cytotoxicity tests were performed before and after hyperthermia in order to estimate the percentage of cells killed by heat induction. The magnetic field of 340 Oe resulted to maximum temperature reached 45^o C at time intervals < 600 s. Viability measurements following hyperthermia showed that the majority of cancer cells died with only a few cells surviving the heat induction (0-10%). Thus, the generated MNPs were taken up by cancer cells and induced killing of tumor cells after hyperthermia *in vitro.* Malignant cells are more sensitive than normal cells to the harmful effects of elevated (≤45^{o}C) temperatures. It is worth mentioning here, that although magnetic nanoparticle hyperthermia is not an established cancer treatment yet, its supporting role to standard cancer treatments like chemotherapy and radiation can increase the efficacy of treatments leading to more effective results.