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Interaction of Magnetic Nanoparticles in Cells of Human Breast Adenocarcinoma (MCF-7)

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Nanotechnology is a field of interdisciplinary and multidisciplinary research with numerous potential applications and scientific advances in the treatment of cancer [1] [2]. In the search for alternatives to improve efficiency and minimize the effects of non-invasive treatments, magnetic nanoparticles (MNPs) are the most promising candidates due to their superparamagnetic behavior, biocompatibility and easy synthesis [3]. Thus, the objective of this study was to evaluate the cytotoxic activity, using the MTT assay, and analyze possible morphological changes by SEM in breast cancer cells (MCF-7), exposed to the MNPs (Fe_3O_4) and MNPs coated with chitosan (CS-Fe_3O_4). For the MTT assay, the cells were treated with different concentrations of Fe_3O_4 and CS-Fe_3O_4 for 24 and 48 hours. For the SEM, cells treated and incubated for 48 h with Fe_3O_4 and CS-Fe_3O_4 were fixed, dehydrated, critical point-dried in CO_2, sputter-coated with gold and observed using FEI Scios. Analysis by TEM showed that the MNPs have a spherical shape and the CS-Fe_3O_4 are more dispersed and less agglomerated in relation to Fe_3O_4. It was observed in the MTT assay that Fe_3O_4 and CS-Fe_3O_4 were not statistically cytotoxic in MCF-7 for all concentrations and incubation periods. MCF-7 treated with Fe_3O_4 and CS-Fe_3O_4 and visualized by SEM showed that both MNPs showed similar morphology to control, presenting cells of polygonal shape, well adhered to the substrate and covered with numerous microvilli and not seem to have been changed by the treatment with the MNPs. In this way, in biomedical applications, the CS-Fe_3O_4 can open new possibilities in use as carriers of drugs.

References:
[1] E M Ali et al., Int J Biol Macromol. **120** (2018), p. 1170.
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[4] This research was supported by CNPq (Brazil).

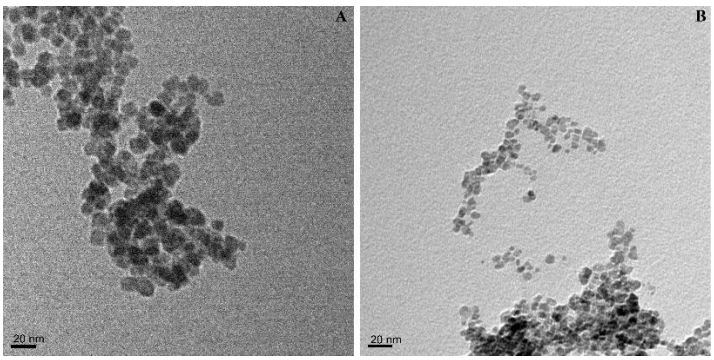

Figure 1. Transmission electron microscopy for magnetic nanoparticles (A) Fe_3O_4 and (B) CS-Fe_3O_4.

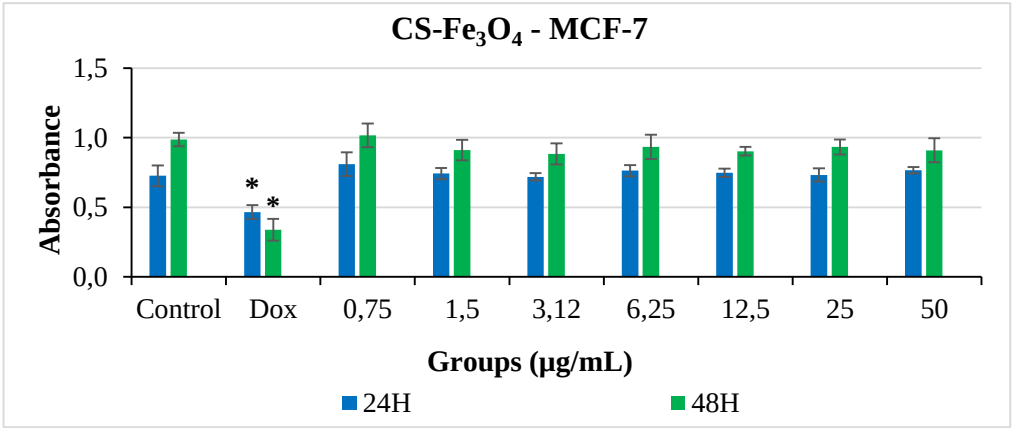

Figure 2. Mean and standard deviation obtained by the MTT test. Groups: Control (DMEM + 10% FBS), and different concentrations of CS-Fe_3O_4 (0.75, 1.5, 3.12, 6.25, 12.5, 25 and 50 µg/mL) were incubated with MCF-7 cells for 24 and 48 hours. *Statistically significant difference in relation to control ($p < 0.05$).

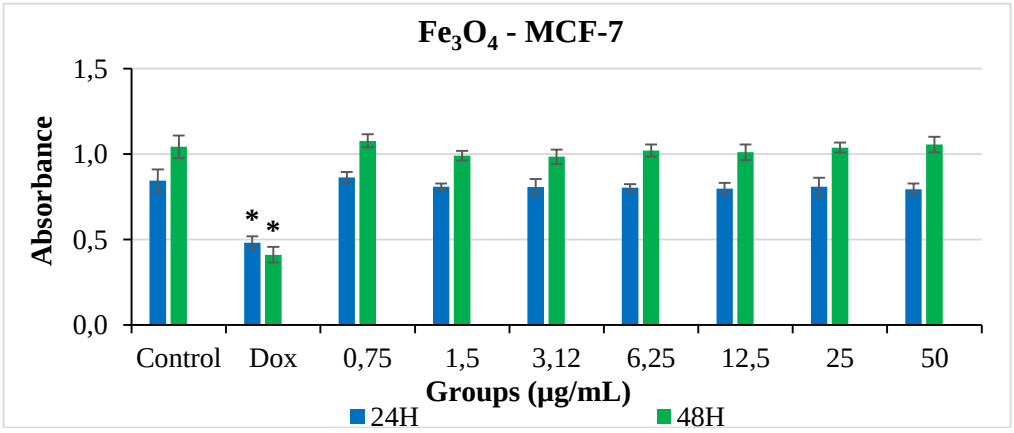

Figure 3. Mean and standard deviation obtained by the MTT test. Groups: Control (DMEM + 10% FBS), and different concentrations of Fe_3O_4 (0.75, 1.5, 3.12, 6.25, 12.5, 25 and 50µg/mL) were incubated with MCF-7 cells for 24 and 48 hours. *Statistically significant difference in relation to control ($p < 0.05$).

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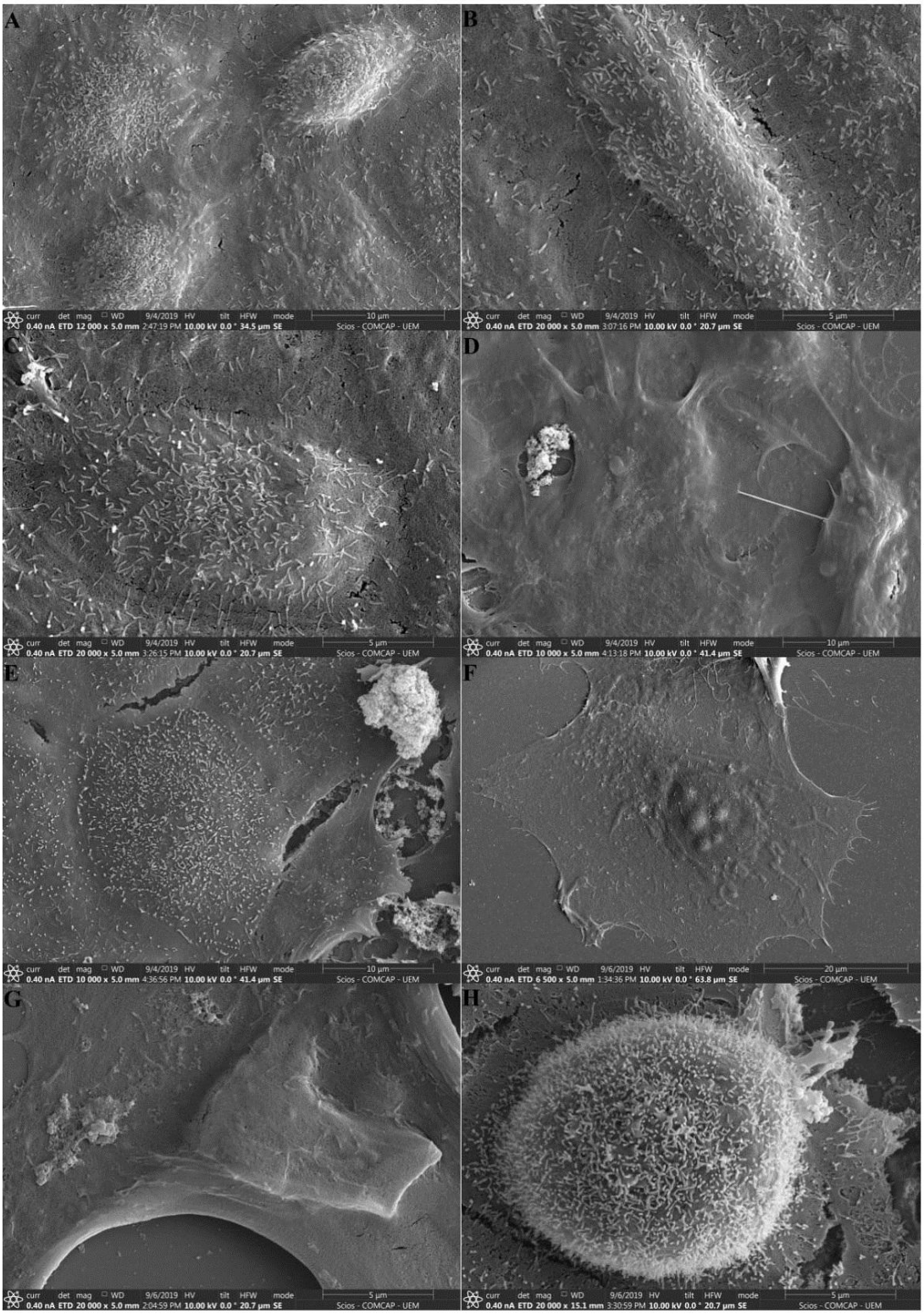

Figure 4. Scanning electron microscopy (SEM) images of MCF-7 cells, incubated with different magnetic nanoparticle treatments for 48 hours. (A, B) Control (C) Fe_3O_4 6.25µg/mL; (D) Fe_3O_4 25µg/mL; (E) Fe_3O_4 50µg/mL; (F) CS-Fe_3O_4 6.25µg/mL; (G) CS-Fe_3O_4 25µg/mL; (H) CS-Fe_3O_4 50µg/mL.

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