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MAGNETIC Fe3O4 NANOPARTICLES COATED WITH PEG, PRODUCTION, CHARACTERIZATION AND BIOLOGICAL TESTS.

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Iron (II,III) oxide nanoparticles (MNPs) are approved for medical use by the US Food and Drug Administration. These MNPs tend to agglomerate and may result in possible side effects. To prevent these issues, MNPs may be covered with polymers, such as poly(ethylene glycol) (PEG), which is biocompatible and provides resistance to the MNPs. The objectives of this work were to produce MNPs coated with PEG, to characterize the material and further perform cellular tests. The nanoparticles were prepared by co-precipitation using Fe(II) e Fe(III) in a 1:2 rate dissolved in deionized water, under vigorous stirring at 60°C. Ammonium hydroxide was added using drops until the pH reached 11. The solution was stirred for one hour. Subsequently, 15ml of PEG was added using drops at 110ºC, and then stirred for 1 hour. The covered MNPs were separated from the solution with a magnet, further washed with isopropyl alcohol and deionized water, and kiln-dried. The structure, packing and crystallite sizes of coated ferrite were assessed by DLS, XRD and FTIR spectral analysis. The biological tests consisted of the evaluation of toxicity of the nanoparticles by 3-(4,5-dimethylthiazol-2-yl)-2,5-diphenyltetrazolium bromide assay (MTT) in the cell line HaCat after one week of treatment. MTT is a colorimetric assay for assessing cell metabolic activity, which is related to cell viability. The HaCat was plated with a cell density of 10,000 cells per well into 96- well culture plates and treated with different concentrations of nanoparticles (0 to 4,000 μg/mL), resuspended in the culture medium,which was Dulbecco's modified eagle's medium (DMEM) with high glucose. Mean aggregate size was of 871.1 ± 122.9 nm, demonstrating variation in the size. The X-ray diffractograms of both pure and covered samples show only reflections of spinel Fe3O4, with no reflections associated with secondary phases. XRD data also shows a pronounced broadening, which indicates crystallite sizes of a few nanometers. FT-IR spectra of the samples confirm the successful coverage of the nanoparticles with PEG, which gave rise to indicative signals at 2,800 cm-1 and in the fingerprint region at low wavenumbers. The values obtained of mean of absorbance ± standard error and the P-value after ANOVA followed by Tukey test were: 0.304 ± 0.033 for 0 μg/mL; 0.314 ± 0.033 for 100 μg/mL (p ? 0.01); 0.302 ± 0.021 for 200 μg/mL (p ? 0.01); 0.284 ± 0.033 for 500 μg/mL (p ? 0.01); 0.263 ± 0.044 for 1,000 μg/mL (p ? 0.01); 0.219 ± 0.043 for 2,000 μg/mL ($p < 0.01$) and 0.179 ± 0.023 for 4,000 μg/mL ($p < 0.01$). These MTT results related to the number of viable cells showed that 200 to 1,000 μg/mL of nanoparticles did not affect the cell viability of keratinocytes. Concentrations of 2,000 and 4,000 μg/mL showed decreased cell viability. The produced nanoparticles were not toxic until 1,000 μg/mL. The results show that the produced nanosystem can, therefore, be safely used for drug encapsulation.