Can natural oils improve the properties of magnetic nanoparticles? A systematic study of iron oxide nanoparticles coated with oils from Amazon fruits

The use of nanoparticles coated with different materials have been studied by many researchers to improve the quality of nanomaterials for biomedical applications such as controlled drug delivery, image contrast and treatment of cancer by magnetic hyperthermia [1]. In this work, we used oils extracted from ucuúba (Virola surinamensis), bacaba (Oenocarpus bacaba Mart.) and açaí (Euterpe oleracea Mart.) to coat Fe_3O_4 nanoparticles. The ucuúba, bacaba and açaí are native trees of the Amazon forest, whose oils are rich in fatty acids, such as lauric, myristic, steatic, oleic, palmitic, and linoleic acid, with different proportions. These pure oils, free of solvents, were obtained by the extraction method with carbon dioxide in the supercritical state [2], and then added during the synthesis process of iron oxide nanoparticles by thermal decomposition method [3]. The results of X-ray diffraction confirmed the formation of Fe_3O_4 single phase. The average size around 3 nm and spherical morphology of the magnetite nanoparticles was determined by transmission electron microscopy. The study of magnetic properties revealed a saturation magnetization (Ms) enhancement and high values of the anisotropy constant for Fe_3O_4 samples when coated with açaí (91.4 $emu.g^{-1}$; 4.6 10^5 $J.m^{-3}$) and ucuúba (80.6 $emu.g^{-1}$; 9.3 10^5 $J.m^{-3}$) oils, which present a large percentage of saturated total fatty acid. The results indicate that nanoparticles with sizes smaller than around 5 nm present Ms values as high as those found in bulk Fe_3O_4 and higher than those usually obtained for nanoparticles coated with oleic acid [4]. The neutron activation analysis (NAA) nuclear technique was used to determine with high accuracy the mass of Fe in the Fe_3O_4 core of nanoparticles in order to normalize the magnetization values [5]. These results show that natural oils have a great potential to produce stable and quality nanoparticles as compared with conventional coated.

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