Synthesis and characterization of iron oxide (Fe₃O₄) nanoparticles synthesized with bacaba oil

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The need for improvements in the quality of nanomaterials for biomedical applications, such as the manufacture of biosensors, treatment of cancer by magnetic hyperthermia and immobilization and separation of the enzyme, generated a great demand for studies on nanoparticles of different materials. Thus, in this work, samples of iron oxide nanoparticles were synthesized using bacaba oil through a variation of the thermal decomposition method, with the objective of obtaining high quality nanoparticles in terms of crystallinity, morphology and functionality for biomedical applications. Bacaba (Oenocarpus bacaba Mart.) is an original species of the Amazon rainforest, whose fruits are rich in fatty acids present in different proportions, such as lauric, myristic, oleic, linoleic and palmitic acid. The oil was obtained by the method of extraction with carbon dioxide in the supercritical state and added to the process of synthesis of the samples. To investigate the structural, morphological, magnetic and electrical properties of the synthesized particles, we used the technique of X-Ray Diffraction (XRD), Transmission Electron Microscopy (TEM), Neutron Activation Analysis (NAA), and Perturbed Gamma-Gamma Angular Correlation Spectroscopy (PAC), that evaluates the interactions of electric and magnetic fields with the electrical and magnetic moments of a $^{111}$In ($^{111}$Cd) radioactive test core with the samples. The results showed that the samples are probably nanoparticles of magnetite with an average diameter of 5 nm and Fe and Fe₃O₄ concentration of 17.74 ± 0.92% and 24.5 ± 1.3%, respectively. Therefore, 75.5% of the remaining mass may be of organic material, including the carbonic chains that constitute the fatty acids of the bacaba oil that must be coating the nanoparticles. With respect to the magnetic hyperfine property, the samples show phase transition at 850 K, which according to the literature at this temperature the sample becomes paramagnetic. Based on these results, it can be concluded that it is possible to synthesize nanoparticles of iron oxide using bacaba oil, which satisfy some characteristics for possible biomedical applications.