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Better with fat: Synthesis of magnetosomes with high power absorption for a thermo-active drug release

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Liposomes are synthetic system well accepted in the pharmaceutical industry and used in diagnostics and therapeutic treatments [1]. The spherical-structured liposome, formed by a lipidic bilayer with a hydrophilic interior, provides a water-soluble/lipid-soluble medium of controlled size. These structures become permeable at temperatures close to the critical temperature, a value that can be tuned with the use of different lipid compositions [2]. Due to these characteristics, temperature-sensitive liposomes can be created for drug delivery in hyperthermia treatments [3]. Magnetic nanoparticles (MNPs), mainly magnetite Fe_3O_4, have been used in clinical treatments of magnetic hyperthermia (MHT) [4]. Exploiting the characteristics of both systems, MNPs and liposomes, we have produced a novel type of magnetosome and explored the synergy of the Doxorubicin drug with HTMin this thermoactive magnetosome system. By thermal decomposition of organometallic precursors, we have synthesized $Zn_{0.2}Fe_{2.8}O_4$ MNPs of 13 nm size with low dispersion and high colloidal stability. With these optimized nanoparticles, multilamellar magnetic vesicles were synthesized by the reverse-phase evaporation method, which were extruded at 60ºC to form magnetosomes. The lipids used for the synthesis were chosen according to a selected temperature for drug release. Calorimetry experiments show a peak at (52±11)ºC. A detailed analysis with different transmission electron microscopy (TEM) techniques shows a stable and repeatable system.

The MNPs formed linear arrangements covered by a lipidic bilayer, similar to the structures that are formed in magnetostatic bacteria. They present an average size of 900 nm, measured by dynamic light scattering. This arrangement, where the MNPs have a higher interaction, provides particular magnetic characteristics compared to the random distribution of MNPs. The specific loss power (SLP) of both systems under different alternating magnetic fields at different frequencies and in different media was also studied. Magnetosome and MNP internalization curves were analyzed in BV2 cell lines, and TEM images showed the incorporation of both systems in the cells.

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