Magnetoliposomes containing magnesium ferrite nanoparticles for enhanced therapeutic potential of curcumin

Beatriz D. Cardoso,[a] Irina S. R. Rio,[a] Ana Rita O. Rodrigues,[a] B. G. Almeida,[a,b] J. P. Araújo,[c] Paulo J. G. Coutinho[a,b] Elisabete M. S. Castanheira[a]

[a] *Centre of Physics (CFUM), University of Minho, Campus de Gualtar, 4710-057 Braga, Portugal*
[b] *QuantaLab, University of Minho, Campus de Gualtar, 4710-057 Braga, Portugal*
[c] *IFIMUP/IN - Instituto de Nanociência e Nanotecnologia, R. Campo Alegre, 4169-007 Porto, Portugal*

The potential of magnetic nanoparticles for biomedical applications has been recognized due to their unique size and physicochemical properties. Nanoparticles with superparamagnetic behavior are preferred for these purposes, as they exhibit a strong magnetization only when an external magnetic field is applied [1].

The coverage of the nanoparticles with a lipid bilayer improves biocompatibility, preserving the magnetic properties, while providing the ability to transport drugs. Recently, magnetic nanoparticles based on several types of ferrites were entrapped in liposomes or covered with a lipid bilayer [2,3]. These nanosystems can be explored for hyperthermia and controlled drug release applications. The combination with superparamagnetic behavior adds the possibility of effective guidance of the nanoparticles to the site of interest by using an external magnetic field gradient.

In this work, magnesium ferrite nanoparticles with superparamagnetic behavior and sizes around 20 nm (Fig. 1A) were prepared and characterized. The structural and magnetic properties of these nanoparticles were evaluated by XRD, SEM and SQUID. In order to further develop applications in cancer therapy, the prepared $MgFe_2O_4$ nanoparticles were covered with a lipid bilayer (solid magnetoliposomes) or incorporated in lipid vesicles, forming aqueous magnetoliposomes. Solid magnetoliposomes present sizes around or below 100 nm (Fig. 1B), while aqueous magnetoliposomes display hydrodynamic diameters around 150 nm (determined by DLS).

Curcumin is a polyphenolic compound with anti-inflammatory, antioxidant, antimicrobial and anticancer properties. However, the therapeutic use of curcumin has been limited due to its strong hydrophobic character, implying low solubility and stability in aqueous media, and poor bioavailability (reduced absorption, rapid metabolism and systemic elimination). Here, magnetoliposomes based on magnesium ferrite nanoparticles were successfully tested as nanocarriers for curcumin, contributing to enhance the therapeutic potential of this compound in oncological therapy.

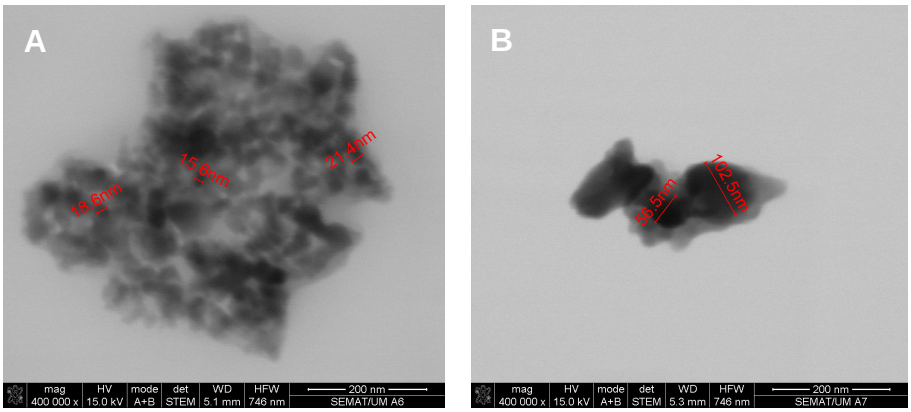

Fig. 1: A. SEM image of magnesium ferrite nanoparticles. **B.** SEM image of solid magnetoliposomes containing $MgFe_2O_4$ nanoparticles.

1) A. Hervault *et al*., *Nanoscale*, **2014**, *6*, 11553.
2) A. R. O. Rodrigues *et al., Phys. Chem. Chem. Phys.,* **2015***, 17,* 18011.
3) A. R. O. Rodrigues *et al.*, *RSC Advances*, **2016**, *6*, 17302.

Acknowledgements:

Financial support by the Portuguese Foundation for Science and Technology (FCT) in the framework of the Strategic Funding UID/FIS/04650/2013. A. R. O Rodrigues thanks the FCT for SFRH/BD/90949/2012 PhD grant and funding to MAP-Fis Doctoral Program.