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Aqueous dispersion of metal oxide nanoparticles, using siloxane surfactants

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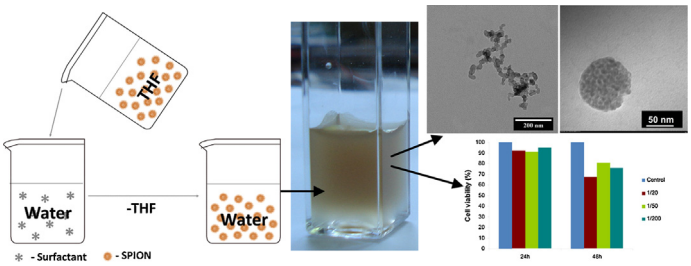
HIGHLIGHTS

- Siloxane surfactants were found biocompatible by MTT cytotoxicity tests.
- Stable water dispersions of SPION were obtained with these surfactants.
- Good cell viability was found for aqueous dispersion of metal oxide nanoparticles.
- Particles of 20–200 nm with different morphology were observed by TEM.
- SPION and an un-soluble drug can be dispersed together in surfactant vesicles.

GRAPHICAL ABSTRACT



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ABSTRACT

Siloxane surfactants containing tromethamol or carboxylate groups, with very good surface properties, are tested for the first time for biocompatibility using MTT cytotoxicity test. They are used for encapsulation of superparamagnetic iron oxide nanoparticles (SPION), and of a combination of these with nystatin as model un-soluble drug, in order to obtain stable aqueous dispersions. The initial magnetite and chromite nanoparticles have been synthesized previously by thermal decomposition thus being covered by dodecylamine and oleic acid. Their aqueous dispersions were obtained by physical methods using very low concentrations of siloxane surfactants, and were investigated by DLS, TEM, cryo-TEM and EDX. One such formulation was tested by MTT method and the results showed high cell viability. The nanoparticles covered with siloxane surfactants exhibited various types of morphology: individual particles, vesicle-like aggregates or composite particles, all having diameters roughly between 20 and 200 nm. The encapsulation of both SPION and nystatin confirmed our previous results on nystatin solubilization by encapsulation within the hydrophobic wall of surfactant vesicles.

1. Introduction

Over the past decades, various nanoparticles were explored for promising applications in the fields of material science, biology, and medicine. Superparamagnetic iron oxide nanoparticles (SPION) are characterized by dimensions under 15 nm [1]. As a consequence of their special properties, several new and exciting biomedical applications have been developed: contrast enhancing agents for MRI [2], drug delivery systems [3], magnetic hyperthermia [4], magnetically assisted transfection of cells [5–8].

Generally, the synthetic methods lead to nanoparticles with organic coatings, which are hydrophobic and allow them to be dispersed only in nonpolar or moderately polar organic solvents. In many cases, oleic acid is coordinated to the iron oxide nanoparticle

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