Scientific report

on the implementation of the project **PN-III-P1-1.1-TE-2019-1671 (contract no.96/2020)**

Co-encapsulated magnetic nanocarriers for theranostic applications in breast cancer: *in vivo* and *in vitro* studies (Project acronym: COTERAN)

Phase I. September-December 2020

Project summary

Cancer is the leading cause of worldwide death for centuries, accounting millions of death annually. Breast cancer is the most frequent cancer in women [1]. Although promising, current therapies including surgery, chemotherapy and radiotherapy are still limited due to: i) lack of selectivity, ii) multidrug resistance and iii) severe toxic side effects [2]. These issues can be addressed by theranostics which has currently emerged as a single smart nanosystem able to assure both diagnosis and therapy [3]. As a family of smart biomedical materials, theranostic nanosystems based on functionalized superparamagnetic iron oxide nanoparticles (SPIONs), could represent the most successful nanotechnological tools due to their appropriate magnetic properties and reduced toxicity [4]. Recent studies have been devoted to development of functionalized SPIONs for theranostic approaches of breast cancer and encouraging results have been reported [5,6]. Moreover, combined chemotherapy, namely co-administration of two or more pharmaceuticals using a multifunctional nanoplatform, has been proposed as a viable solution to overcome the multidrug resistance [7,8].

In this context, **the main objective** of the project is to develop a novel and cost effective way to design smart co-delivery platforms for theranostic applications in breast cancer, by combining the following strategies as key points: i) Co-encapsulation of two chemotherapeutic agents in order to obtain a synergistic effect, without compromising the functionality of each other; ii) The use of a biofunctionalized polymer that combine biotin as a breast tumor targeting approach with amphiphilic chitosan advantanges; iii) Comprehensive biological investigations towards understanding and control of nanoparticulate systems-cell interactions in animal tumour models; iv) Incorporation of a fluorescent marker that enables cell specific imaging in addition to the tissue level imaging using MRI.

The specific objectives are: O1. Synthesis and characterization of new magnetic nanosystems; O2. *In vitro* evaluation of magnetic nanosystem; O3. *In vivo* evaluation of magnetic nanosystems.

Related delivered activities with phase 1: A1.1. Conceptual design of magnetic theranostic nanosystems, analysis and evaluation of their preparation methods; A1.2. Synthesis of magnetic theranostic nanosystems; A.1.3. Physico-chemical characterization of magnetic theranostic nanosystems; A1.4. Project management.

Preliminary results: In a first step, magnetic theranostic systems with less that 300 nm size have been prepared by oil-in-water emulsion. FT-IR spectroscopy confirmed the composition of magnetic nanosystems.

Bibliography:

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