PLGA nanoparticles as advanced imaging nanosystems

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Abstract

Introduction

Polymeric nanoparticles (NP) are of increasing interest in the biomedical field. They represent a promising strategy for *in vivo* diagnosis as medical imaging nanosystems [1]. Due to the possibility of functionalizing nanoparticle surface, these systems can be vectorized to the tissue of interest. In addition, if they include a fluorescent dye nanoparticle tracking can be monitored. Biocompatible, biodegradable and safety materials are required for the preparation of nanoparticles intended for biomedical applications. Therefore, poly(lactic-co-glycolic acid) (PLGA) polymer is appropriate to prepare polymeric nanoparticles using nano-emulsion templating, which is a simple, well-known and versatile method. Nano-emulsions are colloidal systems with droplet size in the range of 20-200 nm. The phase inversion composition method (PIC), a low energy emulsification method, is a suitable methodology to prepare nano-emulsions for pharmaceutical applications as the process can be performed at mild temperature [2]. Following, polymeric nanoparticles can be easily obtained from polymeric O/W nano-emulsions by solvent evaporation, if the oil component (internal phase) of nano-emulsions consist in a preformed polymer dissolved in a volatile organic solvent. The fluorescent dye can be solubilized in the oil phase prior to nano-emulsion formation to enhance high loading efficiency.

Objectives

The aim of this work was to obtain biomedical imaging systems appropriate for intravenous administration.

Results

O/W polymeric nano-emulsions were prepared in a system PBS/ polysorbate80 surfactant/ [4% PLGA and 0.1% fluorescent dye in an organic solvent]. The organic solvent consisted in ethyl acetate or 80/20 ethyl acetate/ethanol. The fluorescent dyes selected were Coumarin 6 (C6) and Rhodamine 6G due to their non-toxic character, appropriate to be used in the biomedical field and also due to their solubility characteristics in the oil phase of the selected system. Nano-emulsions were prepared by the PIC method, at 25ºC. Nanoparticles (Figure 1) were obtained from nano-emulsion templating. Both (nano-emulsions and nanoparticles) were characterized using Zeta Potential (surface charge), dynamic light scattering (DLS, hydrodynamic size) and visual aspect (stability). Nanoparticles and their template nano-emulsions showed hydrodynamic radii below 100 nm and negative surface charges. Nanoparticles sizes were lower than those of their template nano-emulsions. The stability of the nanoparticles allows their use as medical imaging systems. Moreover, the encapsulation efficiency achieved was nearly complete, for both fluorescent dyes, attributed to the nanoparticle preparation method. The fluorescent release was studied for nanoparticle dispersions and for an aqueous and a micellar solutions, for comparative purposes. The Rhodamine 6G release from nanoparticles was slower

than that from the aqueous solution (Figure 2), which is of great interest due to the fact that nanoparticles will reach the target tissue before the fluorescent dye begins to be released.

Conclusion

The formulated polymeric nanoparticles are promising as fluorescent delivery systems for biomedical applications.

References

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[2] G. Calderó, MJ García-Celma, C. Solans, J of Colloid and Interface Science, **535 (2)** (2010) 406-411

Figures

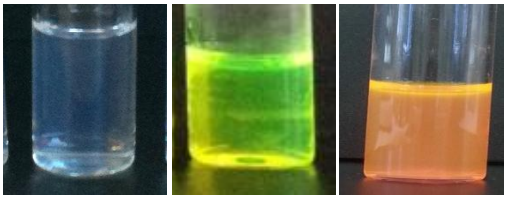

Figure 1. Visual appearance of nanoparticle dispersions.
From left to right: free-NP, C6-NP, Rho 6G-NP

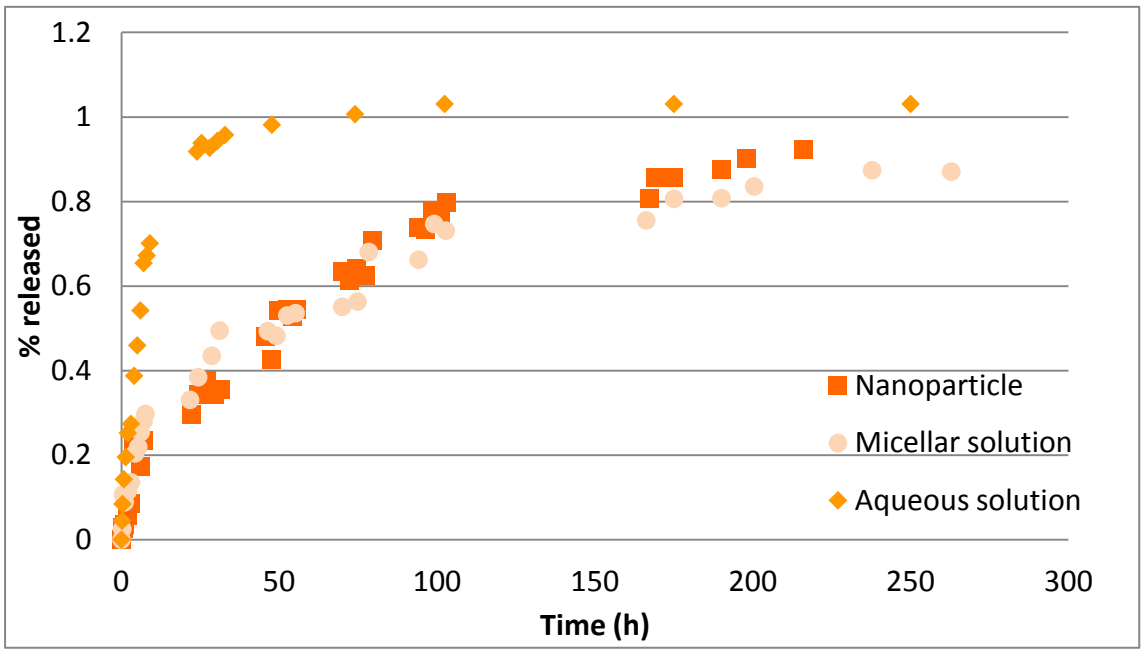

Figure 2. Release of Rhodamine 6G as a function of time for nanoparticles, micellar solution and aqueous solution