Design of multifunctional nanocarriers for biomedical applications

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The design of nanocarriers able to reach selectively the disease site at therapeutic concentrations and at the same time easy to be monitored at real time is a promising way to improve efficacy and decrease adverse effects of drugs. [1-3]. Polymeric nanoparticles are good candidates as starting materials for the preparation of multifunctional nanocarriers. They can be obtained in O/W nano-emulsions by incorporating preformed non-water-soluble polymers in the oily dispersed phase followed by solvent evaporation [4]. Although this method has been known for some time, most studies are based on the use of toxic organic solvents or high temperature procedures. Moreover, commonly, polymeric nano-emulsions are prepared by high-energy methods. Therefore, there is a need of mild procedures combining the use of low-energy emulsification methods and low toxicity components suitable for biomedical applications [5].

The aims of this work were the preparation of biocompatible O/W polymeric nano-emulsions by low-energy methods at 25ºC, their use for nanoparticle preparation by the solvent evaporation method and their functionalization. Nano-emulsions have been formed in water / nonionic surfactant / polymeric organic solution systems by the phase inversion composition method (PIC) at relatively high oil/surfactant (O/S) ratios and characterized by means of several techniques (cross correlation spectrometry, light backscattering, cryoTEM, etc). The nano-emulsion average droplet size (around 200nm) (Figure 1) was found to depend on the O/S ratio as well as the polymer concentration in the organic solution. Some nano-emulsions were chosen for nanoparticle preparation by the solvent evaporation method The nanoparticle average size (typically below 50 nm) was shown to be related to that of the precursor nano-emulsion as determined by tramsmission electron microscopy (TEM) image analysis and their shape was rounded (Figure 2) as evidenced by transmission (TEM) and scanning (SEM) electron microscopy [6]. Further, coumarin-6 was incorporated in the nanoparticles for imaging purposes and folic acid was coupled to the polymer for tumour targeting.

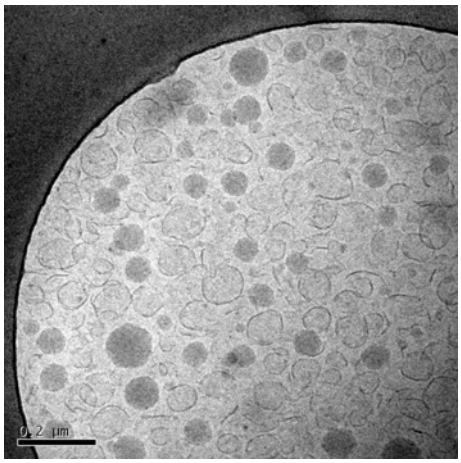

Figure 1: *Cryo-TEM image of the polymeric O/W nano-emulsion with an O/S ratio of 70/30 and 90 wt% of water content.*

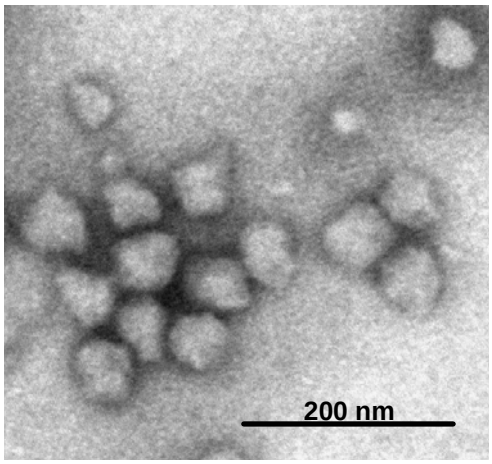

Figure 2: *TEM micrograph of polymeric nanoparticles as observed after negative staining with phosphotungstic acid.*

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