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Preparation techniques of poli-ε-caprolactone nanoparticles: influence on particles size and distribution

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Abstract – Poli-ε-caprolactone nanospheres and nanocapsules were prepared from solvent displacement, solvent evaporation or emulsification/solvent diffusion techniques. The average diameter and size distribution of nanoparticles were evaluated by photon correlation spectroscopy. All formulations presented homogeneous size distribution. Nanoparticles from solvent displacement method presented higher diameter average while those prepared by emulsification/solvent diffusion showed lower diameter average.

Polymeric nanoparticles are drug delivery systems that can be prepared as nanospheres (NE) or nanocapsules (NC). The preparation method is important to be evaluated as it determines nanoparticles characteristics and can later influence drug release [1]. In this study, poli-ε-caprolactone (PCL) NE and NC were developed from solvent displacement, solvent evaporation or emulsification/solvent diffusion techniques. The average diameter and size distribution were evaluated by photon correlation spectroscopy.

In the solvent displacement method, PCL dissolved in acetone was added to a poloxamer solution under stirring, forming nanoparticles. Acetone was eliminated by evaporation under magnetic stirring. In the solvent evaporation method, PCL dissolved in ethyl acetate was emulsified with a poloxamer solution under stirring. The organic solvent was eliminated by evaporation under reduced pressure leading to the formation of nanoparticles. In emusification/solvent diffusion method, PCL dissolved in ethyl acetate saturated with water was emulsified with a poloxamer solution under stirring. Sufficient amount of water was added to the emulsion to allow ethyl acetate diffusion and consequent precipitation of the polymer and formation of nanoparticles. Organic solvent was eliminated by evaporation under reduced pressure. For the preparation of NC, oleic acid was incorporated to the organic solution in all techniques.

The average diameter (AD) and polidispersity index (PI) of the developed nanoparticles are presented in Table 1. Figures 1 and 2 show the size distribution of nanospheres and nanocapsules, respectively. All formulations presented homogeneous size distribution of nanoparticles (Polidispersity index ~0.1). NC presented higher diameter average than NE probably because these have an inner oily core. In solvent displacement method nanoparticles presented higher diameter average when compared to those prepared by emulsification/solvent diffusion technique. The rapid diffusion of acetone to the water allows a faster formation of nanoparticles which can probably explain the higher diameter of the developed particles when compared to those prepared by the other methods. Drug release studies are underway to evaluate the feasibility of these systems for therapeutic applications.

Table 1: Nanoparticles average diameter and polidispersity index.

Methods	Nanospheres		Nanocapsules	
	AV (nm)	PI	AV (nm)	PI
Solvent displacement	210	0,113	230	0,120
Solvent evaporation	166	0,104	192	0,148
Emulsification/ solvent diffusion	158	0,142	165	0,145

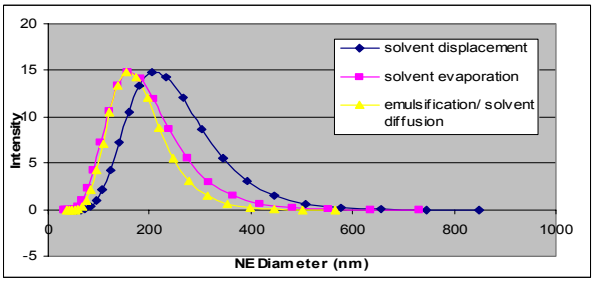

Figure 1: Nanospheres size distribution.

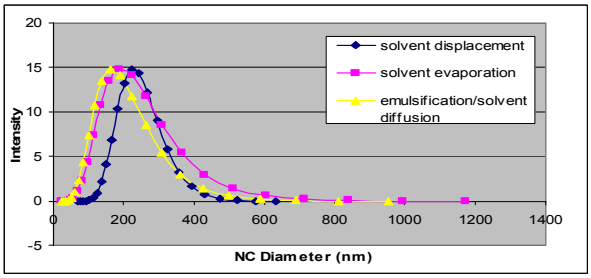

Figure 2: Nanocapsules size distribution.

Reference

[1] C.P Reis, R.J. Ronald, A.J. Ribeiro, F. Veiga. Nanomedicine: Nanotechnology, Biology, and Medicine 2 (2006) 8-21.