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SYNTHESIS OF SILICA PARTICLES LOADED WITH CURCUMIN AND COATED WITH PEG$_{750}$

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Introduction

Mesoporous silica nanoparticles (MSN) have been the centre of studies in different scientific areas nowadays. One of the most promising domains for the study of MSN applications is nanomedicine. They have gained significant advantages over other types of nanoparticles used as transport vectors for drugs. These advantages are primarily due to the adaptable structure depending on the synthesis conditions, high specific surface area and a large pore volume. Also, the manufacture of mesoporous silica nanoparticles is simple, scalable, cost-effective and controllable. The biocompatibility character of MSN depends on several factors, such as size, shape, whether or not the particles are functionalized[1].

One of the major problems with MSN used as drug nanocarriers is the unwanted interactions with the immune system, which cause allergic or rejection reactions. These problems can be avoided, for example, by functionalization with polyethyleneglicols (PEG)[2]. Moreover, PEG is an effective steric stabilizer, capable of reducing the coagulation rate of nanoparticles. As a result, PEG-functionalized silica nanoparticles produced by the sol-gel method have received special attention in recent years[3]. In this study we obtained mesoporous silica nanoparticles functionalized with PEG via a sol-gel process as transport vectors for curcumin, which are intended to be applied in treatment of Alzheimer's disease by preventing fibrillation of β amyloid peptides.

Objectives

- Synthesis of MSN via a sol-gel process;
- Variation of silica co-precursors in order to have a fine control over particles size;
- Improvement of the obtained MSNs biocompatibility by functionalization with PEG$_{750}$;
- Addition of curcumin as an active compound into the obtained transport vectors;
- Physico-chemical characterization of the obtained PEG-silica curcumin-loaded assemblies;

Methods

- The obtained transport vectors have been characterized by TEM microscopy and DLS measurements;
- In order to remove the excess of Tween 80 and DMSO, a purification process through dialysis was performed, using a membrane with MWCO of 6-8 kDa.

Sample	Tween 80 (mL)	H_2O (mL)	Curcumin in DMSO (µL)	Ammonia (µL)	ODTES (µL)	OTES (µL)	Buthanol (µL)	PEG$_{750}$-Si (µL)	Co-precursor (µL)	
									VTES	APTES
B1	0.22	10	50	100	50	-	600	-	-	10
B3	0.22	10	50	100	50	-	600	-	50	10
B4	0.22	10	50	-	50	-	600	-	-	10
B5	0.22	10	50	-	50	-	600	-	50	10
D1	0.22	10	50	100	-	50	600	-	-	10
D3	0.22	10	50	100	-	50	600	-	50	10
D4	0.22	10	50	-	-	50	600	-	-	10
D5	0.22	10	50	-	-	50	600	-	50	10
VB1	0.22	10	50	100	50	-	600	40	-	10
VB3	0.22	10	50	100	50	-	600	40	50	10
VB4	0.22	10	50	-	50	-	600	40	-	10
VB5	0.22	10	50	-	50	-	600	40	50	10
VD1	0.22	10	50	100	-	50	600	40	-	10
VD3	0.22	10	50	100	-	50	600	40	50	10
VD4	0.22	10	50	-	-	50	600	40	-	10
VD5	0.22	10	50	-	-	50	600	40	50	10

Table 1. Compositions of B, D, VB and VD series

Fig 1. Aspect of B series samples (without PEG) 24 h after synthesis

Fig 2. Aspect of VB series samples (with PEG) 24 h after synthesis

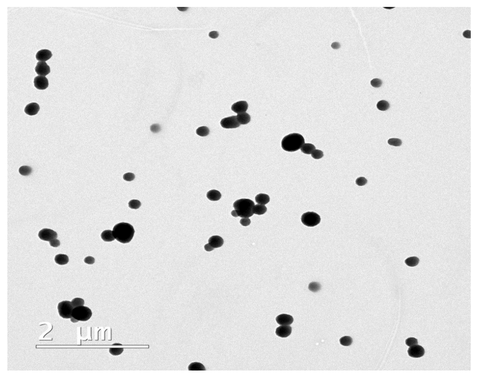

Fig 3. TEM image of B3 sample

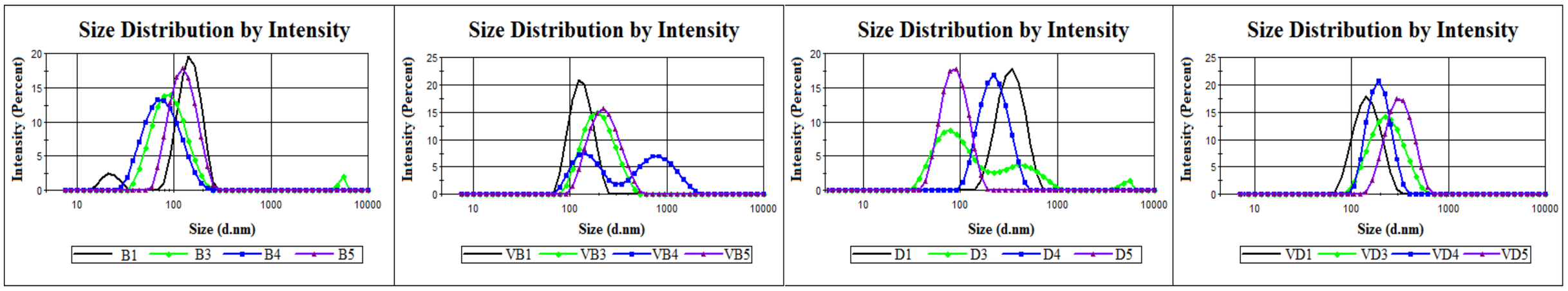

Fig 4. DLS results of: a) B series, b) VB series, c) D series and d) VD series

Conclusions:

- Our aim was to create PEG-silica nanoparticles loaded with curcumin, with potential applications in the treatment of Alzheimer's disease;
- Tween 80 was used as a template for the in-situ produced silica network due to its biocompatibility which makes it suitable for medical applications;
- Four different sets of samples were prepared in order to study the influence of silica co-precursor over the MSNs size;
- Size and morphology of the obtained vectors were studied by TEM and DLS techniques;
- Even though ODTES has a larger chain than OTES, B series particles are smaller in size than D series particles;
- With the addition of PEG, particles' size increases;
- Future prospects of this work regard biocompatibility and release profile studies.

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