Effects of Mixing Mode on the Formation of Silica Nanoparticles Synthesized via Aqueous Sol-Gel Process

T. ANDREANI 1, A. L. R. SOUZA 1,2 A. M. SILVA 1,3, C. L. MARTINS 4, E. B. SOUTO 4

1 Department of Biology and Environment, University of Trás-os-Montes and Alto Douro, Vila Real, Portugal
2 Faculty of Pharmaceutical Sciences, UNESP, Araraquara, Brazil
3 Centre for Research and Technology of Agro-Environmental and Biological Sciences, Vila Real, Portugal
4 Department of Pharmaceutical Technology, Faculty of Health Sciences, UFP, Porto, Portugal

E-mail: ttandreani@hotmail.com (T. Andreani)


Nanoparticles composed of silica and its derivatives are currently in use both in basic scientific research and applied engineering development. Precursor silica particles have been investigated for applications in microelectronics, chemical, biological sensors, as targeting devices and in drug delivery [1]. The efficacy and quality of these products is highly dependent on the size and polydispersity of the silica nanoparticles [2]. The aim of this work was to compare two mixing modes, i.e. ultrasonication vs magnetic stirring, in the synthesis of silica nanoparticles. These nanoparticles were produced applying the aqueous sol-gel method [3] at room temperature via hydrolysis and condensation of tetraethyl orthosilicate (TEOS) using HCl as catalytic agent. Particle size was measure by dynamic light scattering (DLS) and the morphology of nanoparticles was assessed by transmission electron microscopy (TEM). Ultrasonication and magnetic stirring allowed the production of particles with mean average size of 485.9 nm and 81.8 nm, respectively. TEM micrographs showed that particle aggregation is stronger under ultrasonication process in comparison to magnetic stirring. This result was attributed to the nanoparticles collision enhanced by the higher input of energy of sonication which is minimized under magnetic stirring. Furthermore, the latter provides a more uniform energy distribution in the dispersion contributing to better assembling of these particles. The formation of homogenous, monodispersed nanometer silica particles depends on the reaction conditions and parameters e.g. TEOS concentration, pH, temperature and H2O/TEOS ratio.

Acknowledgements: This work was supported by FCT, SFRH/BD/60640/2009 to T. Andreani and by Capes to A.L.R. Souza. We are thankful to Dr. L. Fernandes for TEM assistance.


Presented at the 8th Central European Symposium on Pharmaceutical Technology, September 16th–18th 2010, Graz, Austria.