SYNTHESIS AND CHARACTERIZATION OF GOLD NANOPARTICLES

[1]B. Albertini, [1]A. Schoubben, [1]E. Cassetti, [1]P. Blasi, [1]M. Ricci

[1]Dip. Chimica e Tecnologia del Farmaco, Università degli Studi di Perugia, Perugia, Italy.

e-mail: barbara13.alb@gmail.com

Purpose. The aim of this study was to synthesize gold nanoparticles (AuNPs) to use in therapeutics and diagnostics for different diseases and in particular for cancer.

Methods. NPs were synthesized by the reduction of Au^{+3} ($HAuCl_4$) to Au^0 using four different methodologies. In the first method, AuNPs were prepared by reduction of $HAuCl_4$ using citrate as both reducing and stabilizing agent[1]. In the second method, citrate acted as reducing agent while an aqueous solution of gelatine (30% w/v) was used as stabilizing agent[2]. Gelatine creates a network which limits ionic diffusion to restrict NP growing. With this method, three batches were prepared adding the gelatine solution in different predetermined time. In the third synthesis, AuNPs were obtained mixing an aqueous solution of $HAuCl_4$ with an aqueous Pluronic P84 solution[3]. The copolymer was used as both reducing and stabilizing agent. In the last method, glycerine was employed to reduce Au^{3+} to Au^0. Photon Correlation Spectroscopy (PCS), also known Dynamic Light Scattering (DLS), was used to characterize AuNPs in terms of size and stability. Particle size was expressed as mean hydrodynamic diameter ± standard deviation.

Results. The four methodologies yielded NPs characterized by different dimensions. NPs obtained using citrate showed a mean diameter of 16.59±1.79 nm. After thirty days of storage at room temperature, the mean particle size slightly increased (19.30±1.63 nm) and a new particle population (38.60±1.41 nm), accounting for 2.65% of the total, was observed. The use of gelatine as stabilizing agent did not change the NP mean size and stability in comparison with the first method. However, when gelatine was added before starting the reaction, reduction to Au^0 lasted 20 days. AuNPs obtained using Pluronic P84 showed three populations (18.66±9.06 nm, 91.96%; 127.53±1.71 nm, 7.63%; 210.4±4.7 nm, 0.77%) while glycerol yielded just two populations; the first one (91.7%) of 17.76±1.75 nm and the second (8.3%) of 122.03±0.98 nm. After ten days, AuNP prepared with the last 2 methods described showed no or minimal particle size variation.

Conclusion. AuNPs prepared using the different methodologies are characterized by different particle size and are stable upon storage at room temperature for at least 10 days. The different methods, avoiding the use of organic solvents, can be considered as green synthesis.

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[1] P. Zhao, N. Li, D. Astruc. State of art in gold nanoparticles synthesis. Coord. Chem. Rev. 257 (2013) 638-665;

[2] M. Neupane, S. Lee, I. Park, M. Lee, T. Bae, Y. Kuboki, M. Uo, F. Watari. Synthesis of gelatin-capped gold nanoparticles with variable gelatin concentration. J. Nanopart. Res. 13 (2011) 491-498;

[3] T. Sakai, P. Alexandridis. Single-step synthesis and stabilization of metal nanoparticles in aqueous pluronic block copolymer solutions at ambient temperature. Langmuir 20 (2005) 8426-8430.