Synthesis and characterization of Au-198 nanoparticles for radiotherapy.

M. Rigo, A. Barbezan, C. Talacimon, L. Teodoro, P. Rodrigues, W. Rosero, T. Nogueira, and M. Rostelato.

rigomaria110@gmail.com, Instituto de Pesquisas Energéticas e Nucleares (IPEN/CNEN), Avenida Professor Lineu Prestes, 2242, Cidade Universitária, São Paulo SP, CEP 05508000, Brazil

Introduction

Nanomedicine has incredible potential to revolutionize cancer therapy and diagnosis by developing biocompatible nanocompounds for drug delivery purposes, with the most pertinent application being nanoparticles (NPs) [1].The premise of using NPs in brachytherapy is the possibility of treating the tumor in a way that minimizes the radiation dose to adjacent healthy tissues. In this way, the small size of the particles would allow greater diffusion in the tumor, thus creating a homogeneous distribution of NPs and, consequently, a uniform distribution of radiation. Therefore, this work focuses on the development of a gold-198 nanoparticle (AuNPs-198) applicable in brachytherapy. Aiming at the physical-chemical characterization stages of the same.

Methodology

The synthesis of AuNPs-198 was based on adaptations of the Turkevich method [5].
The irradiated gold wire was dissociated using an acidic solution of hydrochloric and nitric acids in a 3:1 ratio. The previous process allowed the production of chloroauric acid ($HAuCl_4$). The coloring of $HAuCl_4$ and the final solution of radioactive gold nanoparticles (AuNPS-198) can be seen in Figure 1

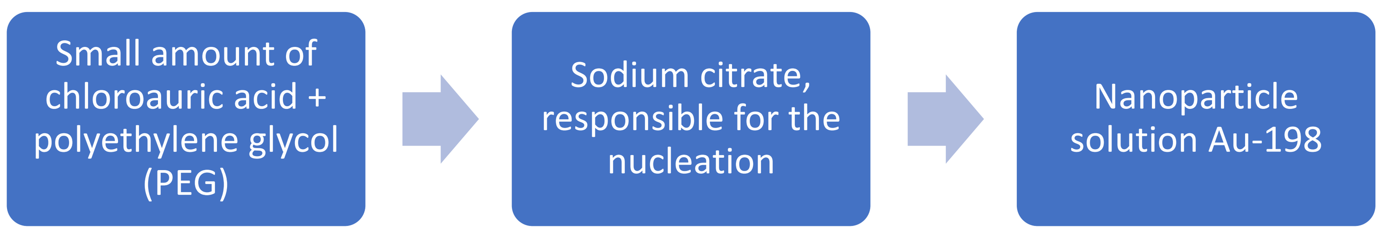

Figure 1 – The reddish solution is AuNPs-198 and the yellowish solution is $HAuCl_4$.

Physicochemical characterization was used to evaluate the size of the samples, for this purpose Dynamic Light Scattering (DLS) was used and to evaluate the radionuclide spectrum a Hyperpure Germanium (HPGe) detector was used.

Results and Discussion

Before carrying out the synthesis to obtain AuNPs-198, gamma spectrometry was carried out. The average activity of the AuNPs (671 µCi ± 5 µCi) made it possible to read the sample positioned next to the detector. The live reading time for each sample was 7200 seconds. The spectrum obtained from metallic gold is shown in Figure 2.

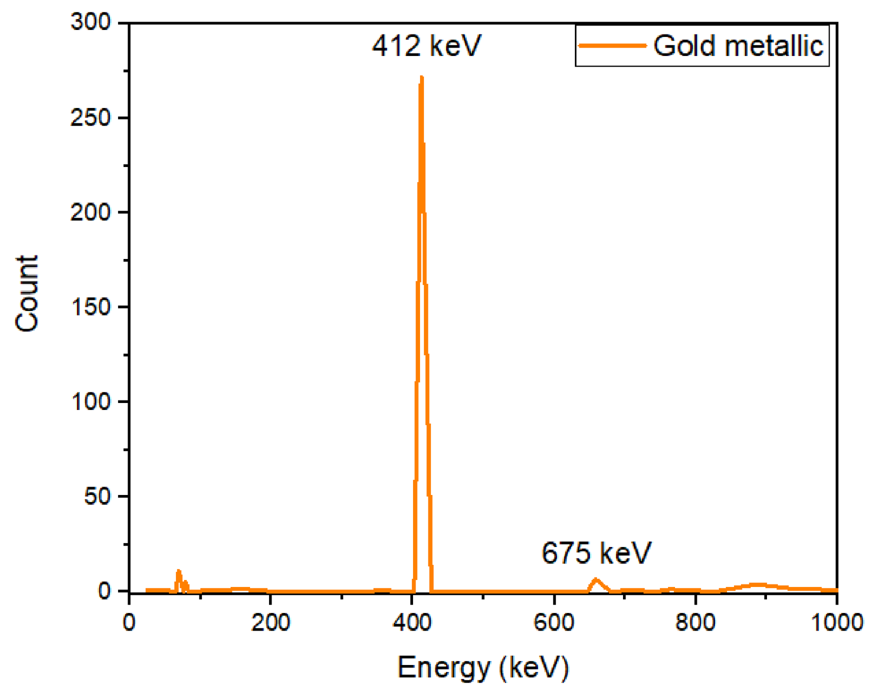

Figure 2 - Gamma radiation spectrum obtained from metallic Au-198.

The results of the DLS analysis provided the distribution profile of the hydrodynamic diameter of the nanoparticles when subjected to tests over 0.5 hours, 24 hours and 10 days after their production. Each measurement moment was done in triplicate. Figure 3 shows the monodisperse and stable distribution profile of AuNPs-198 over time.

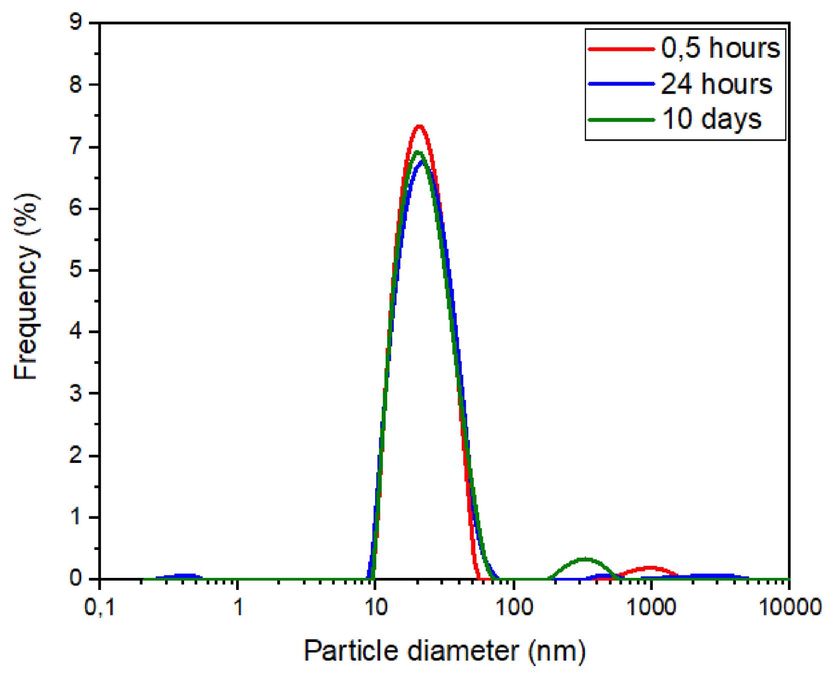

Figure 3 – Distribution profile of AuNPs-198 (radioactive) tested in three periods of 0.5 h, 24 h and 10 days after being produced.

Conclusions

The synthesis developed specifically for the production of gold nanoparticles proved to be stable, where the DLS technique revealed an average hydrodynamic size of 23 nm. For future work, it is suggested that the nanoparticles obtained by the method be tested in vitro and in vivo to trace the cytotoxic profile.

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