



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

1. 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 radiation dose to adjacent healthy tissues, since they can be inserted directly into the tumor, thus avoiding the unwanted effects of radiation treatment and reducing the patient discomfort.

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. It is important to highlight that the literature has shown that brachytherapy with NPs is effective in inhibiting tumor growth [2,3,4].

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.

2. 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. Then, chloroauric acid (HAuCl₄) was obtained, being the fundamental component for the synthesis of gold nanoparticles. To obtain the nanoparticle solution, a small amount of chloroauric acid, polyethylene glycol (PEG) and sodium citrate was required, which is responsible for the nucleation and formation of gold-198 nanospheres. The physical-chemical characterization served 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.

3. Results and Discussion

Here you show your results in a compact fashion and give a brief discussion. Before carrying out the synthesis to obtain AuNPs-198, gamma spectrometry was carried out. The average activity of the AuNPs ($671 \mu\text{Ci} \pm 5 \mu\text{Ci}$) 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 1.

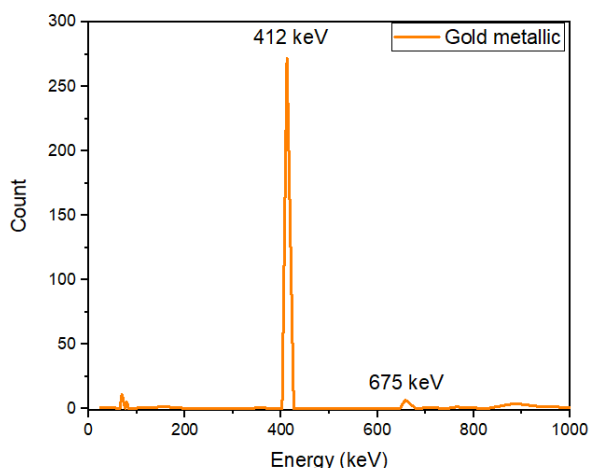


Figure 1 - Gamma radiation spectrum obtained from metallic Au-198.

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 2 shows the monodisperse distribution profile of NPs over time.

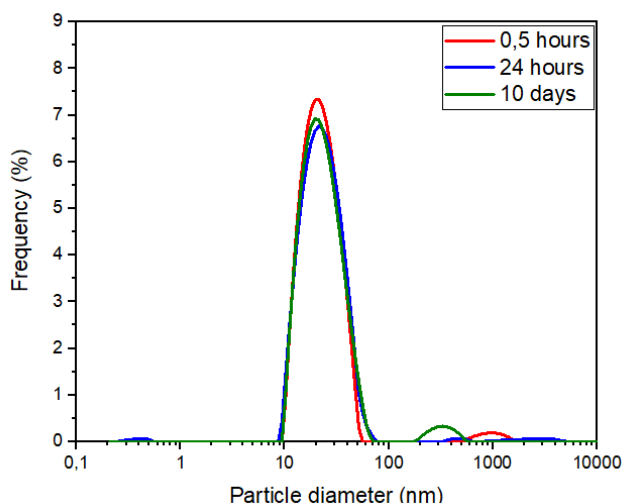


Figure 2 – Distribution profile of AuNPs-198 (radioactive) tested in three periods of 0.5 h, 24 h and 10 days after being produced.

4. Conclusions

Therefore, the synthesis developed specifically for the production of gold nanoparticles proved to be stable, where the DLS technique revealed that the nanoparticles obtained have 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.

Acknowledgements

To agencies FAPESP 2017/50332-0, CNEN and IAEA BRA-6062 for financing the project and providing scholarships.

References

- [1] Misra, Ranjita et al. "Cancer nanotechnology: application of nanotechnology in cancer therapy." *Drug discovery today* vol. 15,19-20 (2010).
- [2] Chanda, Nripen et al. "Radioactive gold nanoparticles in cancer therapy: therapeutic efficacy studies of GA-198AuNP nanoconstruct in prostate tumor-bearing mice." *Nanomedicine: nanotechnology, biology, and medicine* vol. 6,2.
- [3] Shukla, Ravi et al. "Laminin receptor specific therapeutic gold nanoparticles (198AuNP-EGCg) show efficacy in treating prostate cancer." *Proceedings of the National Academy of Sciences of the United States of America* vol. 109,31 (2012).
- [4] Yook, Simmyung et al. "Intratumorally Injected ¹⁷⁷Lu-Labeled Gold Nanoparticles: Gold Nanoseed Brachytherapy with Application for Neoadjuvant Treatment of Locally Advanced Breast Cancer." *Journal of nuclear medicine: official publication, Society of Nuclear Medicine* vol. 57,6 (2016)
- [5] J. Turkevich, et al. "A study of the nucleation and growth processes in the synthesis of colloidal gold", *Discussions of the Faraday Society*, vol. 11, pp. 55-75 (1951).