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RELATO DE CASOS - 2° CONGRESSO CANCERTHERA EM CONJUNTO COM O 18° SIMPÓSIO EDWALDO CAMARGO

PRODUCING IODINE-131 FROM TELLURIUM-130 NEUTRON ACTIVATION: STUDY OF FEASIBILITY IN THE ARGONAUTA RESEARCH REACTOR AT IEN

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A B S T R A C T

Introduction/Justification: Modern oncology faces challenges when treating elderly patients, who often have limited responses to conventional chemotherapy. To address this, theranostics combines diagnostic and therapeutic properties of radioisotopes in the same molecule, enabling personalized medicine. Iodine-131 (I-131) is a pioneering theranostic radionuclide widely used in Nuclear Medicine, for thyroid cancer due to its high affinity for thyroid tissue and beta and gamma radiation emission. In Brazil, the production and supply of I-131 are managed by the Nuclear and Energy Research Institute (IPEN) in São Paulo. However, delivering short-lived radioisotopes to remote regions presents challenges that may cause delays, affecting clinical and research applications. This highlights the need for alternative production methods to ensure timely availability of crucial radionuclides. This study explores the feasibility of producing I-131 through neutron activation of tellurium-130 at the Argonauta Research Reactor at the Nuclear Engineering Institute (IEN) in Rio de Janeiro. The Argonauta reactor, in operation since 1965, has been used for R&D in nuclear technology and the training of human resources for Brazil's Nuclear Program. Its team has optimized I-131 synthesis from tellurium-130 via neutron activation. The reactor's Nuclear Instrumentation and Radiochemistry laboratories are equipped for radiochemical processing, purification, and gamma spectrometry. Developing a validated I-131 production method at IEN would benefit local research and reduce dependence on external suppliers. **Report:** In the methodology, high-purity tellurium dioxide (TeO2) was irradiated for one hour at a neutron flux of 10^9 n/cm^2·s. After irradiation, I-131 was isolated using a radiochemical separation process. The irradiated oxide was dissolved in sodium hydroxide solution (4 mol/L), followed by hydrochloric acid (1 mol/L) addition to adjust the pH to 5-6. The separation method ensured I-131 retention in the aqueous phase. Gamma spectrometry confirmed radionuclide half-life, radionuclidic purity, and activity levels. The results demonstrated successful I-131 production with radionuclide purity over 95% within four hours post-irradiation. The highest activity was observed approximately 10 hours after neutron activation. Decay curve analysis confirmed the expected half-life of 8.025 days, consistent with literature values. The study also highlighted the efficiency of the radiochemical separation method in minimizing contamination from tellurium-131. **Conclusion:** These findings indicate that the proposed method is a viable alternative for local I-131 production, particularly for research purposes. While the activity levels achieved are suitable for experimental applications, further optimizations, such as increasing neutron flux, extending irradiation time, or improving chemical processing efficiency, may be required to meet higher activity demands in nuclear medicine. Future work will focus on refining the process to scale up production while maintaining the stringent purity and safety standards needed for medical applications. The successful implementation of this technique could provide a reliable and accessible source of I-131 within Brazil, benefiting the scientific community.

Keywords: Argonauta reactor, Iodine 131, Neutron activation, Tellurium.

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