A Simple Method for Measuring Lu-177m Contaminants in Lu-177 Based Therapeutics

Saskya Arias Soriano MS; David Coll Segarra PhD; Sameer V. Tipnis PhD; Jonathon A. Nye PhD
Medical University of South Carolina, Charleston, SC

2026 JULY 19–22 VANCOUVER, BC
JOINT AAPM | COMP MEETING

ABSTRACT No. 24049

INTRODUCTION

Purpose: We present a method to measure and quantify ^{177m}Lu in ^{177}Lu-based radiopharmaceutical therapy.

Radiopharmaceutical therapy has expanded rapidly with the adoption of ^{177}Lu-based agents such as Lutathera® and Pluvicto®. ^{177}Lu has a favorable half-life (~6.64 days) and emission profile for therapy and imaging.

The production route impacts the presence of the long-lived contaminant ^{177m}Lu (~160-day half-life), which has implications for waste handling and regulatory compliance.

Production of ^{177}Lu

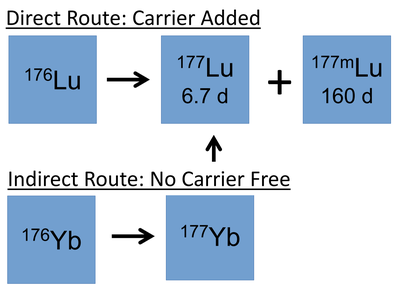

Figure 1. Direct and indirect production routes for ^{177}Lu. The direct production route includes a small cross-section for ^{177m}Lu.

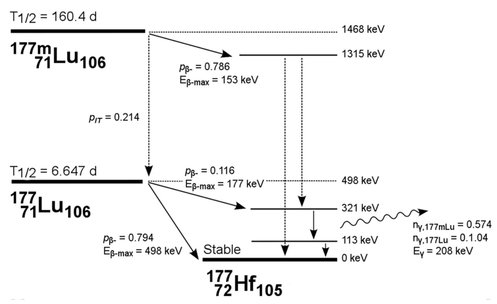

Figure 2. Decay scheme for ^{177m}Lu→^{177}Lu→^{177}Hf. Adapted from ref. 3

METHODS AND MATERIALS

- 24 samples were collected from unused patient vials (14 Lutathera®, 10 Pluvicto®)
- 1 mL aliquots were analyzed on the following detectors:
  - HPGe detector
  - NaI well detector
  - Liquid scintillation counter (LSC)
- All detector systems were calibrated using traceable standards
- Spectra were collected on each detector system and integrated over the ^{177m}Lu photopeaks of 108 keV, 113 keV, and 120 keV

METHODS AND MATERIALS

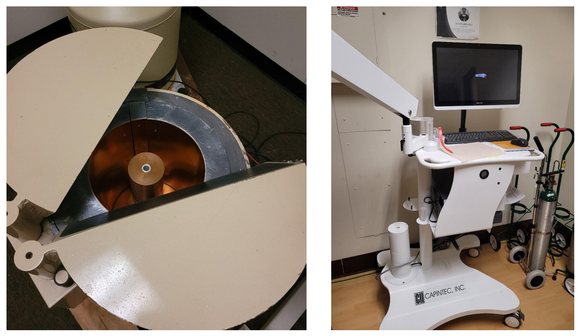

Figure 3. (left) HPGe well in shielding enclosure at the University of South Carolina and (right) NaI well in the nuclear medicine department at the author's institution.

- Individual peaks of 108 keV, 113 keV, and 120 keV could not be resolved on the NaI well and these peaks were combined for all measurements

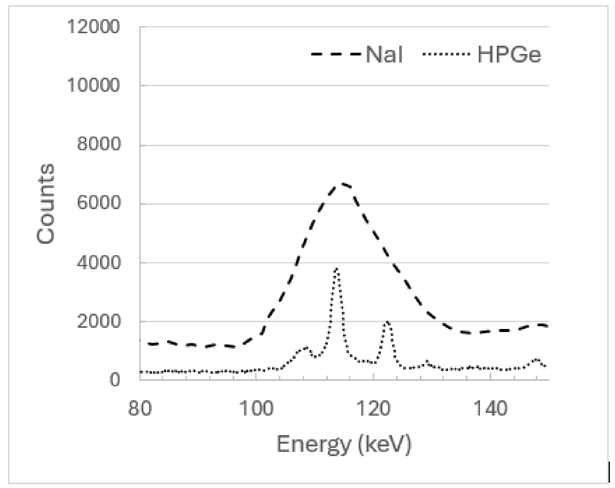

Figure 3. Comparison of HPGe and NaI spectra for the 108 keV, 113 keV, and 120 keV photopeaks collected on a Lutathera® sample.

- The minimum detectable activity (MDA) was calculated from the background under each photopeak.
- Measurements are reported as % ratio of ^{177m}Lu / ^{177}Lu

RESULTS

- Results are shown in table 1.
- There was no statistical difference between ^{177m}Lu / ^{177}Lu ratios for the HPGe and NaI well detectors
- The LSC overestimated the ^{177m}Lu / ^{177}Lu ratio due to contributions from multiple beta decay transitions in the sequence ^{177m}Lu→^{177}Lu→^{177}Hf that could not be resolved.
- The ^{177m}Lu / ^{177}Lu ratio was above the MDA estimate for Lutathera® confirming the presence of ^{177m}Lu
- The ^{177m}Lu / ^{177}Lu ratio for Pluvicto® did not exceed the MDA estimate suggesting the absence of ^{177m}Lu

Table 1. Percent ratio of ^{177m}Lu / ^{177}Lu measured from the HPGe, NaI well and LSC detector systems.

	Lutathera (n=14)		
	HPGe	NaI	LSC
Mean (MDA)	5.86×10^{-3} (1.56×10^{-4})	6.22×10^{-3} (1.19×10^{-4})	8.48×10^{-3} (7.30×10^{-10})
SD	1.73×10^{-3}	1.32×10^{-3}	1.96×10^{-3}
	Pluvicto (n=10)		
Mean (MDA)	4.97×10^{-7} (4.43×10^{-6})	6.94×10^{-7} (1.09×10^{-5})	2.45×10^{-5} (7.87×10^{-9})
SD	8.53×10^{-7}	1.12×10^{-6}	1.65×10^{-5}

MDA = Minimum Detectable Activity

DISCUSSION

- HPGe and NaI well detectors provide sufficient sensitivity to measure and quantify trace amounts of ^{177m}Lu
- LSC systems can detect ^{177m}Lu activity but lack specificity for quantification
- All Lutathera® samples in this study had measurable amounts of ^{177m}Lu. These amounts were consistent with other literature reports
- None of the Pluvicto® samples had ^{177m}Lu that exceeded the MDA
- The presence of ^{177m}Lu likely reflects the production method used to source ^{177}Lu.

CONCLUSIONS

- A practical hospital-based methods for detecting ^{177m}Lu was demonstrated
- Some, but not all, ^{177}Lu-based therapeutics contain measurable amounts of ^{177m}Lu
- HPGe and NaI spectroscopy are preferred for detection and quantification
- LSC is not suitable for quantification due to beta decay interference.

REFERENCES

1. Balzer, M., F. Spiecker, S. Bluemel, H. Amthauer, W. Brenner and S. Spreckelmeyer. Evaluation of the (177m)Lu-concentration in in-house produced (177)Lu-radiopharmaceuticals and commercially available Lutathera((R)). EJNMMI Radiopharm Chem 8: 37; 2023. DOI:10.1186/s41181-023-00222-2
2. Dash, A., M. R. Pillai and F. F. Knapp, Jr. Production of (177)Lu for Targeted Radionuclide Therapy: Available Options. Nucl Med Mol Imaging 49: 85-107; 2015. DOI:10.1007/s13139-014-0315-z
3. Gleisner, K. S., G. Brolin, A. Sundlov, E. Mjekiqi, K. Ostlund, J. Tennvall and E. Larsson. Long-Term Retention of 177Lu/177mLu-DOTATATE in Patients Investigated by gamma-Spectrometry and gamma-Camera Imaging. J Nucl Med 56: 976-984; 2015. DOI:10.2967/jnumed.115.155390
4. Kim, K. and S. J. Kim. Lu-177-Based Peptide Receptor Radionuclide Therapy for Advanced Neuroendocrine Tumors. Nucl Med Mol Imaging 52: 208-215; 2018. DOI:10.1007/s13139-017-0505-6
5. Prevot, S., I. Dygai-Cochet, J. M. Riedinger, J. M. Vrigneaud, M. Quermonne, M. Gallet and A. Cochet. Dealing with dry waste disposal issues associated with (177m)Lu impurities: a long-term challenge for nuclear medicine departments. EJNMMI Phys 10: 3; 2023. DOI:10.1186/s40658-023-00524-z

CONTACT

Jonathon A. Nye
Medical University of South Carolina
99 Jonathan Lucas Dr. Charleston, SC 29425
jan301@musc.edu