

# Radiolabeling Comparison of Accelerator Versus Generator Produced $^{225}\text{Ac}$

Vanessa A. Sanders, Cathy S. Cutler

Actinium Session

June 28<sup>th</sup>, 2020

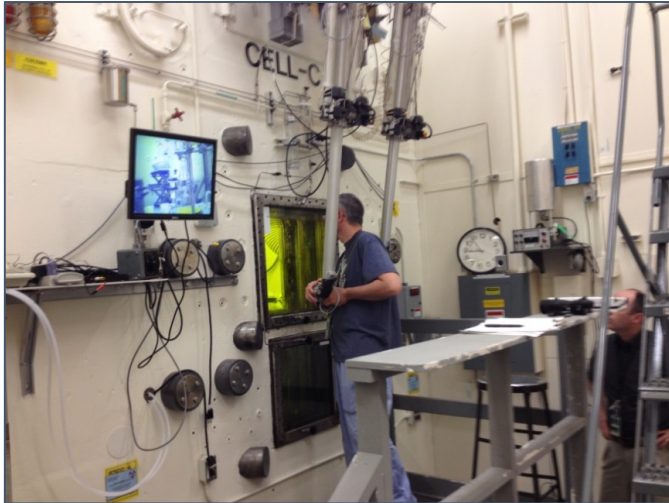
**BROOKHAVEN**  
NATIONAL LABORATORY



BROOKHAVEN SCIENCE ASSOCIATES

# Tri-Lab Effort

Leveraging Unique Isotope Program Facilities, Capabilities, and Expertise to Address  $^{225}\text{Ac}$  Supply



ORNL - Approximately 25 years of experience in the isolation of  $^{225}\text{Ac}$  from fissile  $^{233}\text{U}$  via  $^{229}\text{Th}$



LANL Isotope Production Facility (IPF) at LANSCE; 100 MeV incident energy up to 275  $\mu\text{A}$  for routine production



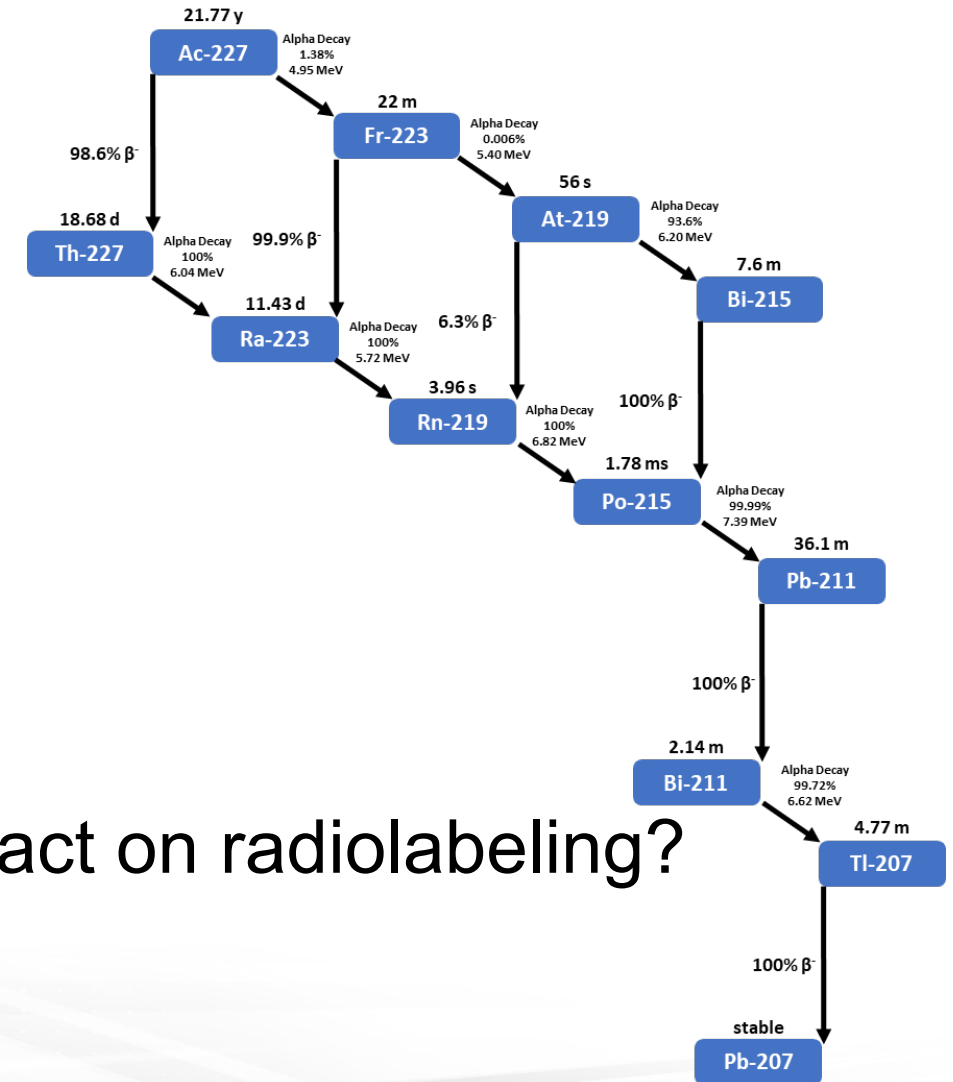
BNL Linac at the Brookhaven Linac Isotope Producer (BLIP) 165  $\mu\text{A}$  intensity to targets at incident energies ranging from 66-202 MeV

# Routine Accelerator Production of $^{225}\text{Ac}$

- Stage 2: Routine production of 50-100 mCi  $^{225}\text{Ac}$ 
  - Continued optimization/evaluation of targets
  - Continued optimization of processing for direct  $^{225}\text{Ac}$  and  $^{225}\text{Ac}/^{213}\text{Bi}$  generator
  - Implementation of chemistry
  - Targetry scale up
- Stage 3: Routine production of 100-1000 mCi  $^{225}\text{Ac}$

# Accelerator Production of $^{225}\text{Ac}$

- 0.2 % coproduction of  $^{227}\text{Ac}$
- $t_{1/2} = 21.78 \text{ y}$
- Complicated decay scheme
  - Th
  - Rn
  - Pb
- Will these daughter products have an impact on radiolabeling?



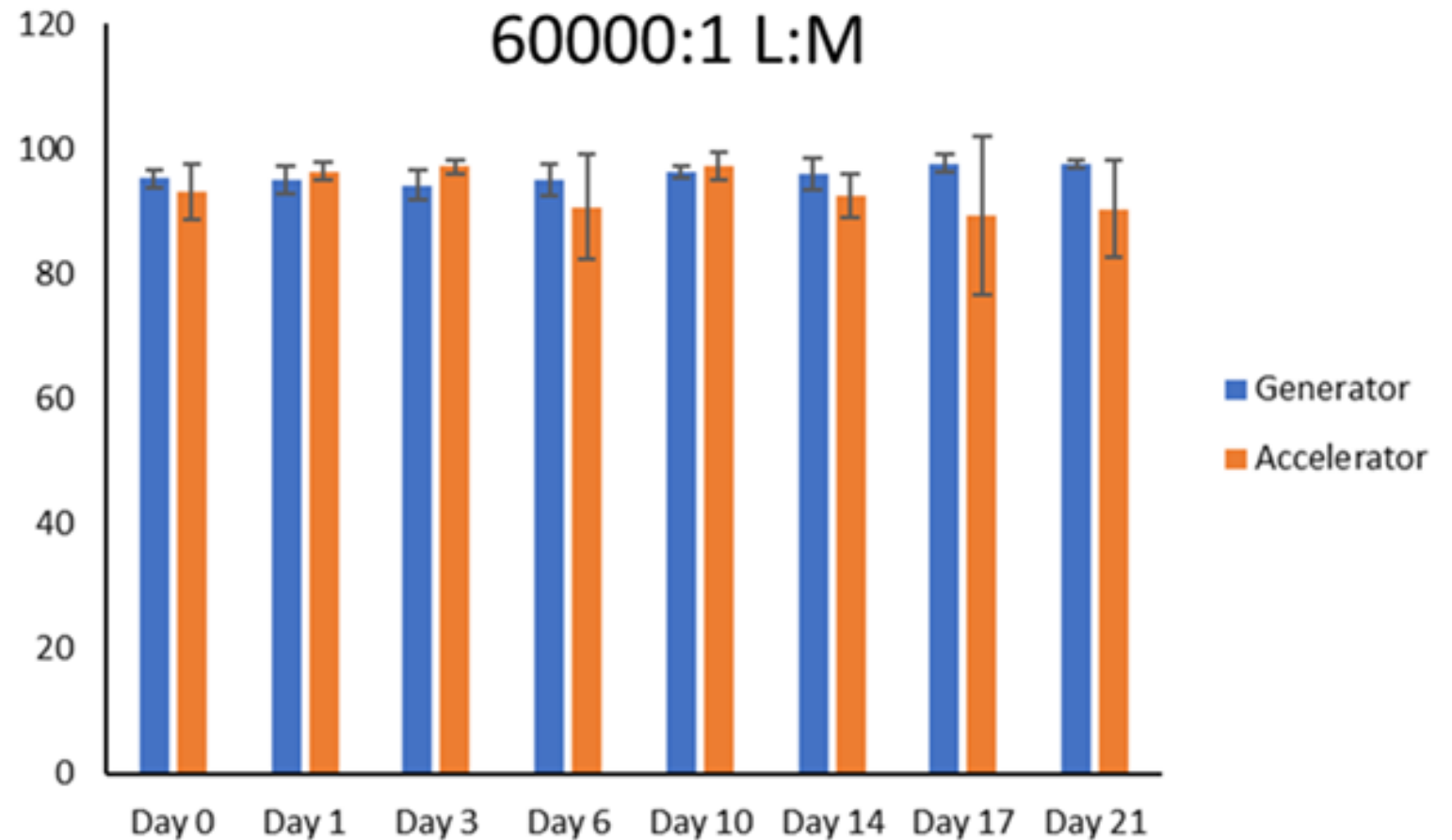


# Motivation/Protocol

- To evaluate generator produced  $^{225}\text{Ac}$  radiolabeling yields and compare them to accelerator produced  $^{225}\text{Ac}$  radiolabeling yields
- Evaluate impact of presence of Ac-227
- Determine if differences are observed with time
- Used literature methods of clinical studies
- 50  $\mu\text{Ci}$  per reaction
- 100  $^{\circ}\text{C}$  for 30 minutes
- Timepoints
  - 0, 1, 3, 6, 10, 14, 17, 21 days post delivery.
- ITLC
  - Solvent 50/50  $\text{NH}_4\text{OAc}$ /Methanol<sup>1</sup>
- Varied conc. of ligand
  - 25  $\mu\text{mol}$  to 5 picomol

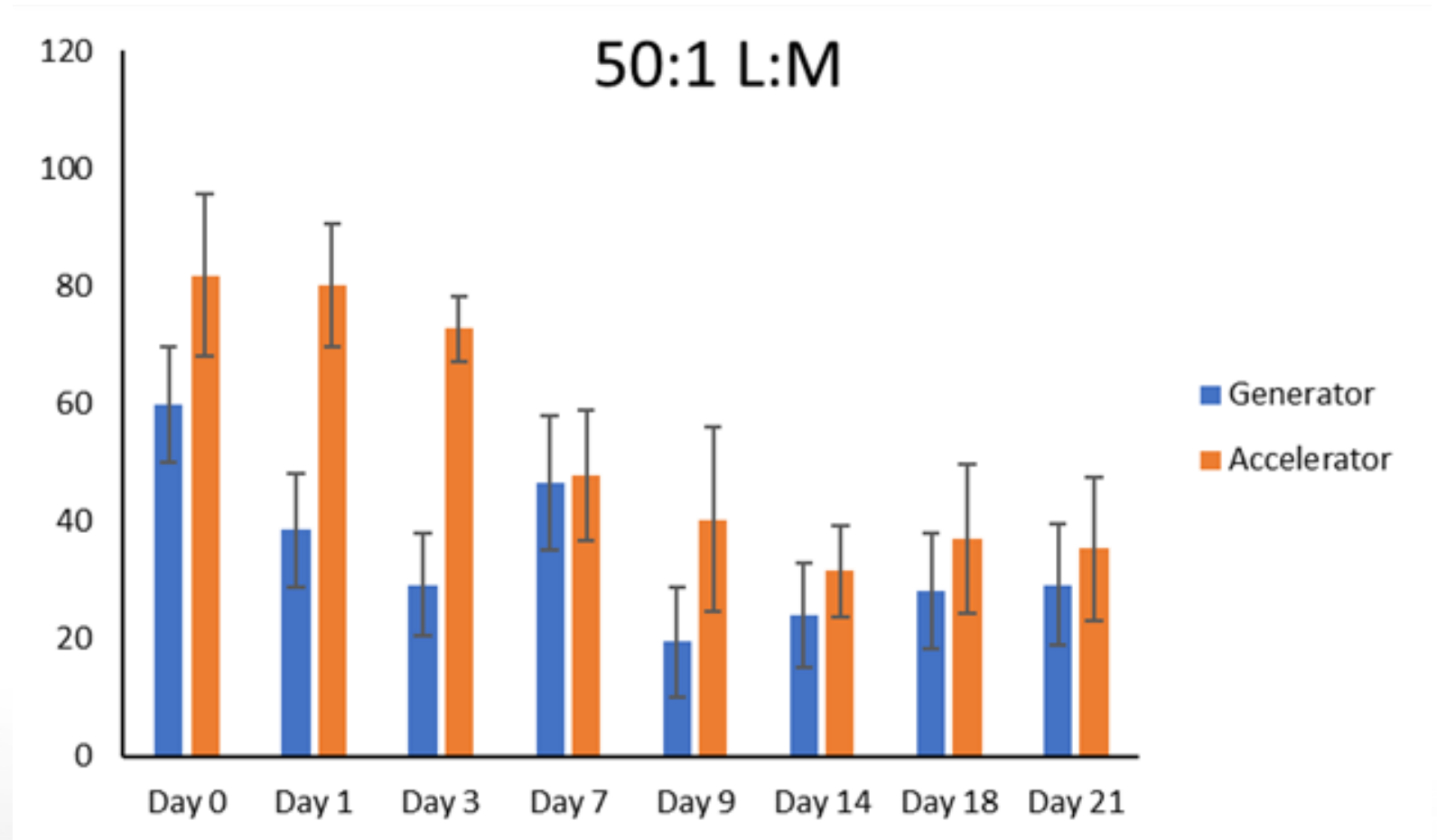
# Results- Excess Ligand Conc.

- 1:60000 M:L
- Generator batch received 08/06/2019
- Accelerator batch received 09/24/2019



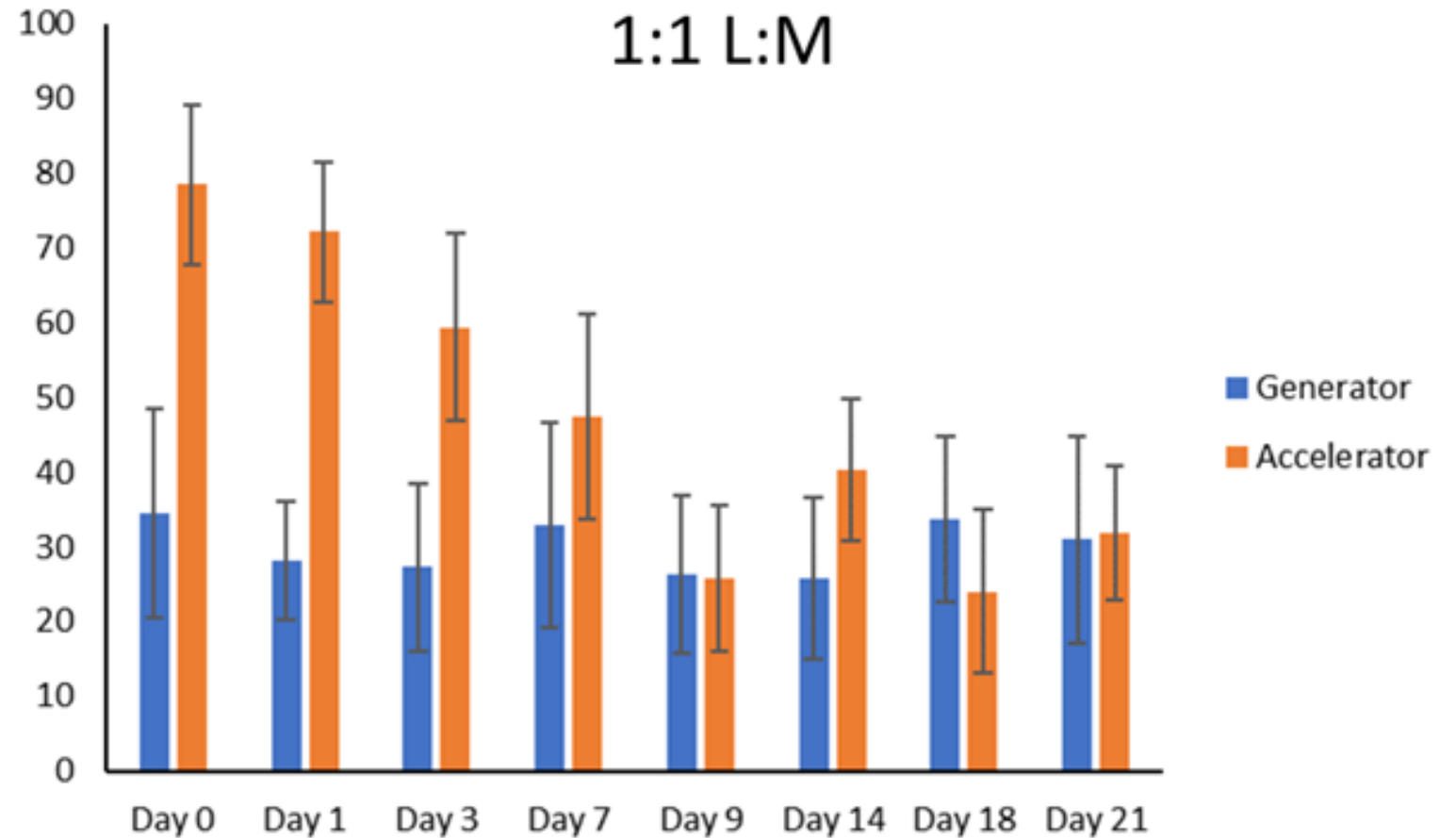
# Results- Moderate Ligand Conc.

- 1:50 M:L
- Generator batch received 11/26/2019
- Accelerator batch received 11/18/2019



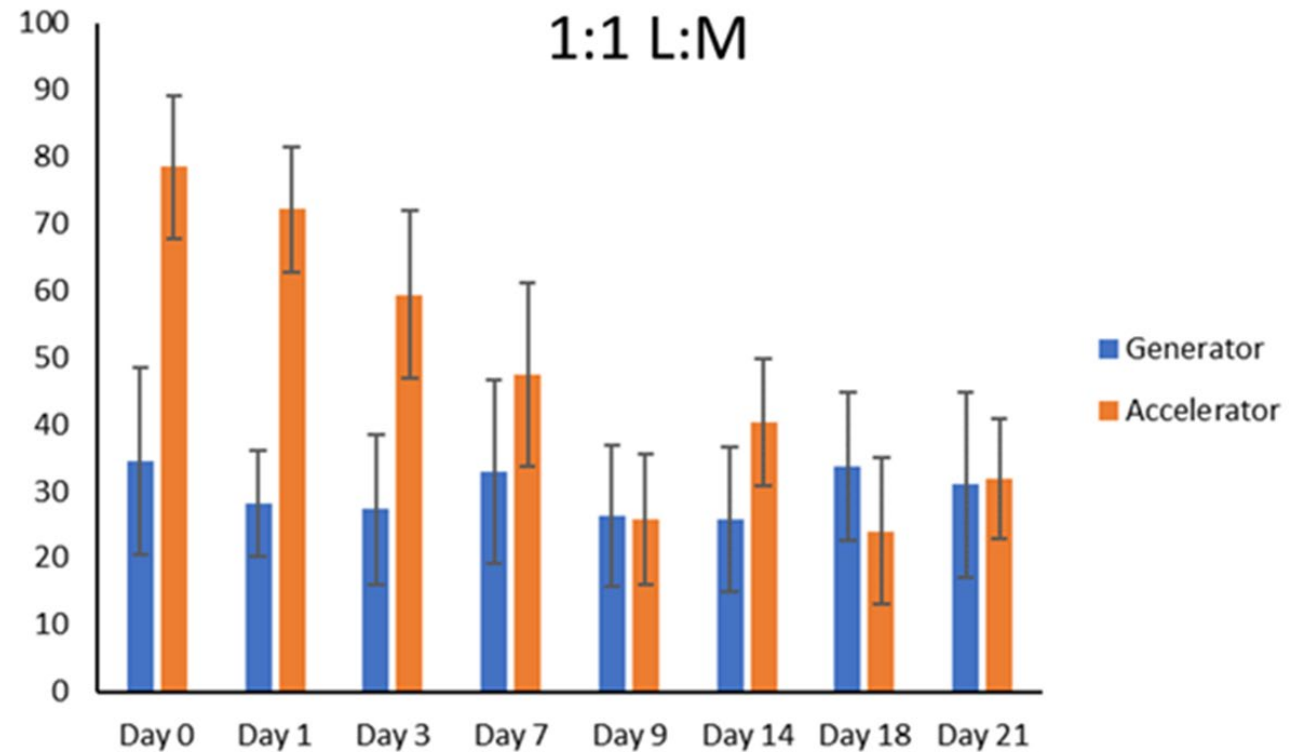
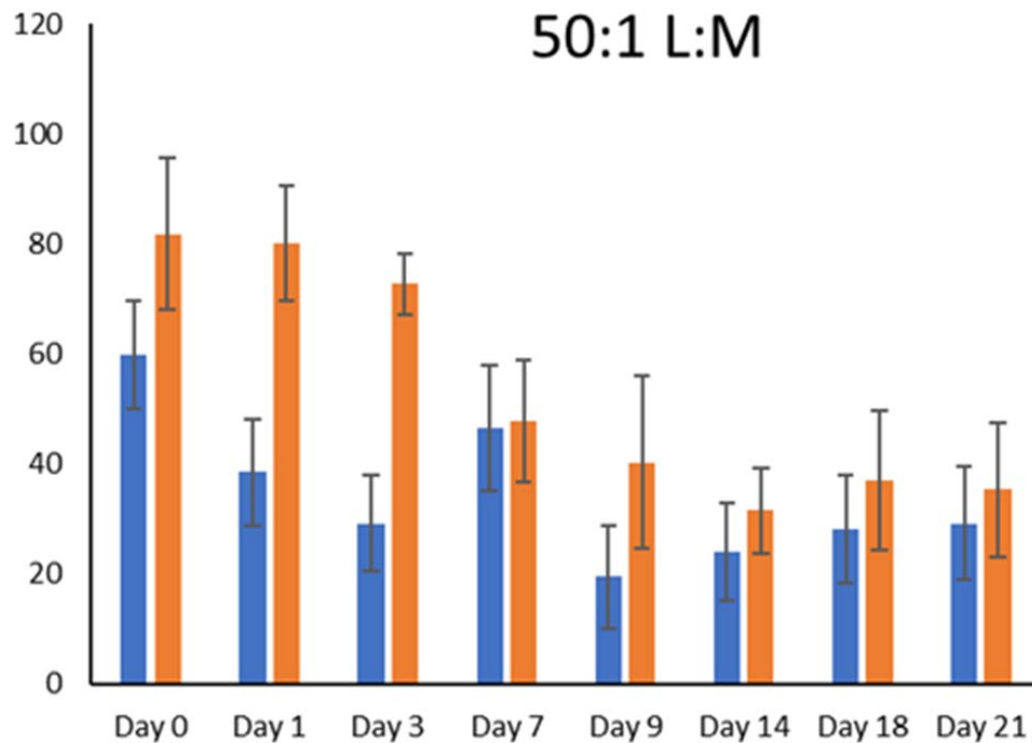
# Results- Low Ligand Conc.

- 1:1 M:L
- Generator batch received 11/26/2019
- Accelerator batch received 11/18/2019



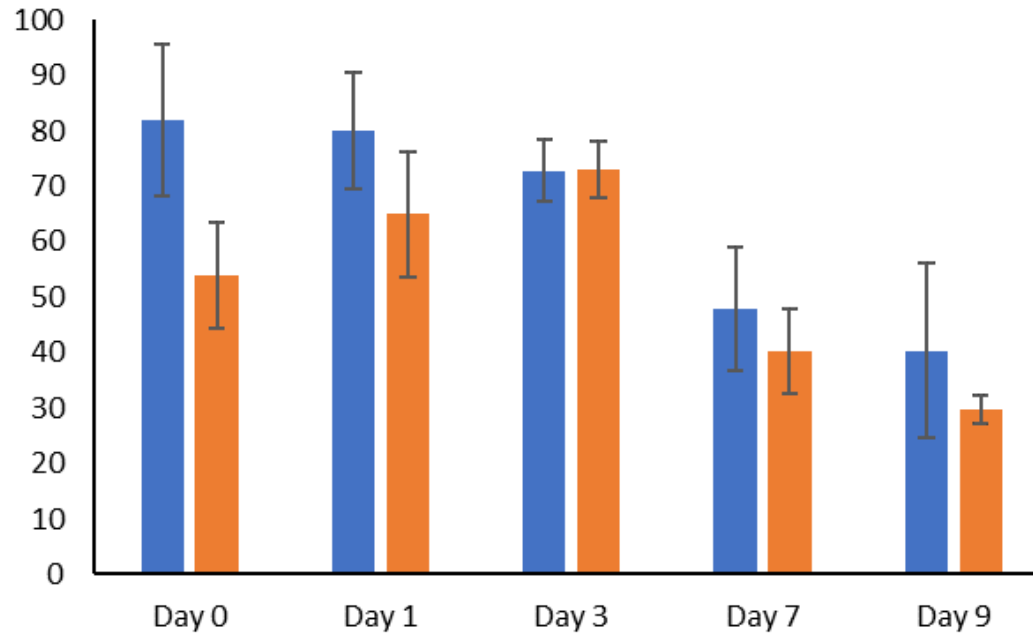


# Results

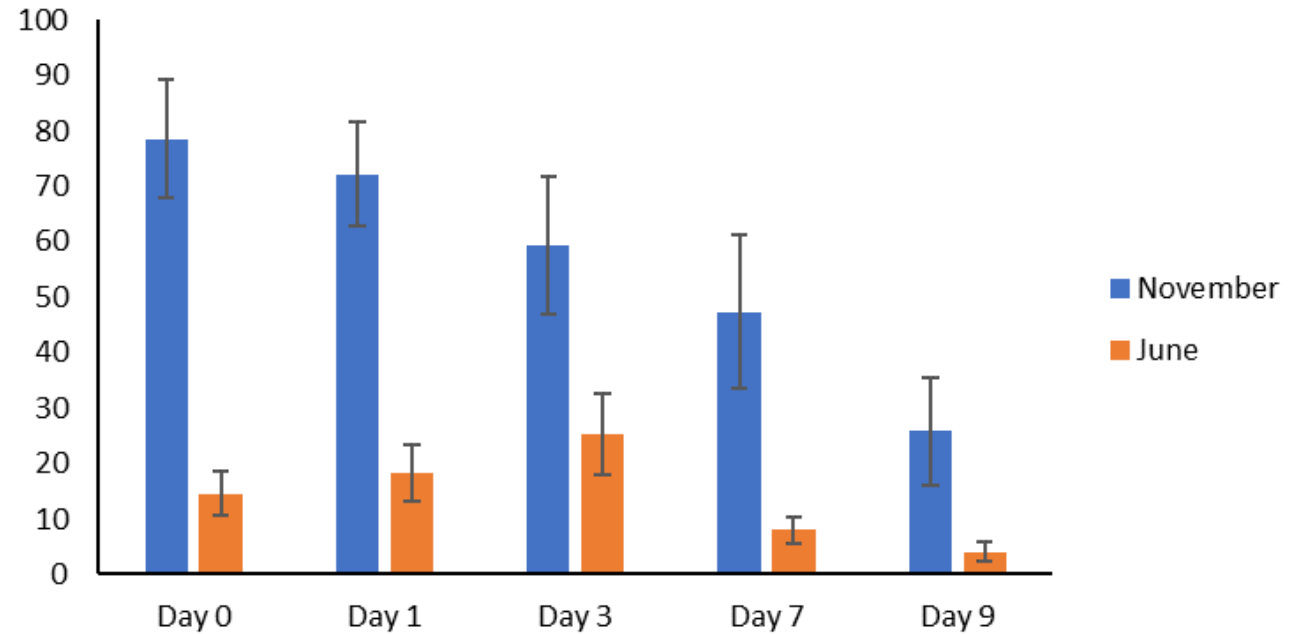


# Results

## Accelerator 50:1



## Accelerator 1:1



# Conclusions and Future Work

- Consistent radiolabeling yields across both production routes
  - At high ligand concentrations
- There is an observed reduction in labeling yield as the ligand concentration is varied
- Accelerator material shows higher labeling yields in early time points
  - 50:1 and 1:1
  - Possible contaminants?
- Evaluation between different batches of product
  - Current results show a trend of lower labeling yields with more recent batch
- Optimization of ITLC protocol
- Determination of Ac-227 content

# Acknowledgements

- Dr. Cathy Cutler
- Medical Isotope Research and Production Group (MIRP)
- Karen Sikes
- Kevin John
- Ariel Brown

DOE Isotope Program  
[www.isotopes.gov](http://www.isotopes.gov)



U.S. DEPARTMENT OF  
**ENERGY**

Office of  
Science





# Questions ???

