

RAPID DETERMINATION OF ^{226}Ra IN EMERGENCY URINE SAMPLES

Sherrod L. Maxwell¹, Brian K. Culligan¹, Jay B. Hutchison¹, Robin C. Utsey¹ and Daniel R. McAlister²

Savannah River National Laboratory, Building 735-B, Aiken, SC 29808, USA
²PG Research Foundation, Inc. Lisle, IL 60532

A new method has been developed at the Savannah River National Laboratory (SRNL) that can be used for the rapid determination of ^{226}Ra in emergency urine samples following a radiological incident. If a radiological dispersive device (RDD) event or a nuclear accident occurs, there will be an urgent need for rapid analyses of radionuclides in urine samples to ensure the safety of the public. Large numbers of urine samples will have to be analyzed very quickly. This new SRNL method was applied to 100 ml urine aliquots, however, this method can be applied to smaller or larger sample aliquots as needed. The method was optimized for rapid turnaround times; urine samples may be prepared for alpha spectrometry counting in <3 hours.

Based on calculations by Saunders using NCRP 161, the ^{226}Ra clinical decision guide (CDG) target levels for ^{226}Ra for pregnant female and for children are estimated to be at 24 Bq L⁻¹ on day 1 and drop to 0.17 Bq L⁻¹ by day 20. [1, 2] The CDG levels for pregnant female and children are 1/5 the target levels for other adults. This new method, using a 100 ml aliquot size, can easily provide a detection limit below these target levels with 1-2 hour count times.

A rapid calcium phosphate precipitation method was used to pre-concentrate ^{226}Ra from the urine sample matrix, followed by removal of calcium by cation exchange separation. To enhance efficiency, a stacked elution method using DGA Resin was used to purify the ^{226}Ra during the cation exchange elution step. This approach combines the cation resin elution step with the simultaneous purification of ^{226}Ra with DGA Resin, saving time. ^{133}Ba was used as a tracer instead of ^{225}Ra to allow immediate counting; however, ^{225}Ra can still be used as an option. The rapid purification of ^{226}Ra to remove interferences using DGA Resin was compared with a slightly longer Ln Resin approach. A final barium sulfate micro-precipitation step was used with isopropanol present to reduce solubility; producing alpha spectrometry sources with peaks typically <40 keV FWHM (Full Width Half Max). This new rapid method is fast, has very high tracer yield (>90%), and removes interferences effectively. The sample preparation method can also be adapted to ICP-MS measurement of ^{226}Ra , with rapid removal of isobaric interferences.

- [1] National Council on Radiation Protection and Measurements (NCRP). (2008). Management of persons contaminated with radionuclides. Report No. 161, Vols.1&2 Available for purchase at http://www.ncrppublications.org/Reports/161_I.
- [2] Saunders, D. Centers for Disease Control and Prevention (CDC), personal communication, December 2013