

Determination of Trace Concentrations of Actinides in the NIST Bone Ash Standard Reference Material Using TRU-Spec Extraction Resin

Zhichao Lin, Kenneth G.W. Inn, and Carlos E. Crespo Hernandez

National Institute of Standards and Technology, Gaithersburg, MD

Bone as a sink of a number of long-lived radionuclides is a key organ for biokinetic model development and dosimetry studies. Development of a bone standard for the bone-seeking radionuclides is one of the most important tasks in ensuring quality control in bone sample analysis and for providing a common basis for data comparison and evaluation. A bone ash standard under development at National Institute of Standards and Technology (NIST) for low-level radioactivity measurements provides a great analytical challenge to radiochemists because of its high calcium and phosphate content. In order to certify the concentration at about 1 mBq/g level radioactivity in the bone standard, analytical procedures using TRU-Spec extraction resin have been developed to overcome the difficulties caused by a high calcium phosphate matrix. Bone samples up to 15 grams are spiked and are refluxed with concentrated HNO_3 and H_2O_2 until the solutions became colorless. The resulting solution is filtered through a 0.1 μm membrane filter at room temperature. The residue is dissolved in concentrated HNO_3 and HF in a microwave oven and then it is combined with the sample filtrate. Actinides in each dissolved sample are separated from the bone matrix as a group on a column containing 4 grams of TRU-Spec resin. A reproducible column yield of greater than 90% is obtained by stripping actinides of the column with 0.1 N $(\text{NH}_4)_2\text{C}_2\text{O}_4$ - 0.1 N HNO_3 . Actinides separation and determination are accomplished by anion exchange procedures and a high resolution alpha spectrometer. The developed procedures are rapid, produce less waste, highly reproducible, and effective in eliminating the difficulties caused by a high calcium phosphate matrix and improve alpha spectral resolution. The procedures can also be applied to determine low activity concentrations of actinides for other types of high calcium and phosphate samples, such as milk and gypsum.