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COMPUTATIONAL APPROACHES ON PHOTON-ATTENUATION AND COINCIDENCE-SUMMING CORRECTIONS FOR THE DETECTION OF GAMMA-EMITTING RADIONUCLIDES IN FOODS

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Content

The U.S. Food and Drug Administration (FDA) faces increasing challenges in safeguarding the nation's food supply against growing threats of nuclear power accidents, global nuclear proliferation, and nuclear facility breaches. To ensure food safety and protect public health, it is imperative that the FDA is capable of rapid and reliable detection and quantification of gamma-emitting radionuclides in foods in the event of a large-scale nuclear or radiological emergency. Gamma-ray spectroscopy is the method of choice for identifying and quantifying gamma-emitting radionuclides and was previously implemented for food analysis in the FDA's radiological laboratory. However, the current method used and its further applications are constricted by the cost and availability of mixed gamma calibration standards needed for counting efficiency corrections that compensate for differences in matrix compositions, food densities, and sample geometries. Furthermore, the lack of suitable calibration standards to facilitate coincidence summing corrections for close volumetric counting geometries, make accurate radionuclide quantification difficult. Source-based calibration methods used for photon attenuation and coincidence summing corrections are time consuming and require multiple certified standards that match sample geometry with varying densities. To overcome these difficulties, a number of software and modeling techniques, which are capable of simulating a variety of sample geometries, matrix compositions, and sample densities have been examined as an alternative calibration method. This study investigated the accuracy of calibration measurements of foods containing known amounts of radionuclides by using both traditional source-based methods and computational methods so that a direct comparison between them can be made. The three different programs evaluated in this work were GESPECOR, Angle 3 by ORTEC and LABSOCS by Canberra. In this study, foods of various densities were examined to understand the relationship that different food matrices have on efficiency calibrations. Organic solutions were also used to improve the scope of densities studied. Efforts were focused on determining the accuracy of these measurements by comparing the results of the software to the measurement of spiked food samples. From the results, it was determined that LABSOCS was the most accurate at replicating measured efficiencies. All of the software packages provided predicted activity levels in the various food samples that are significantly more accurate in comparison to using a water-based efficiency to estimate activity. From the results, a correction factor for density was derived and can potentially be used to eliminate the process of generating a different standard for samples of interest.

About the Presenter

Dr. Rolle completed his Ph.D in Inorganic Chemistry at Georgia Institute of Technology where his work focused extensive research experience in the synthesis and characterization of small molecules. Afterwards he pursued a postdoctoral fellowship at Johns Hopkins University in Chemistry. In his studies, he has investigated the development of environmentally benign transition metal catalysts, as solutions to outstanding problems in bench-top organic synthesis, commodity chemical production and energy storage. Currently, he is Commissioner's Fellow at the Food and Drug Administration with research interests in reducing the impact that anthropogenic sources of chemicals have on human health and the environment.

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