Application of Liquid Scintillation and Gas-flow Proportional Counting Techniques for Simultaneous Detection of Alpha/beta Radioactivity in Food

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Safeguarding the nation's food supply in the event of a large-scale nuclear or radiological emergency presents many challenges, such as developing high-throughput methods to meet vast demand for food testing. Rapid detection of anthropogenic alpha/beta radioactivity in food is difficult due to time-consuming sample preparation, matrix attenuation, and interfering natural radionuclides. Recent interlaboratory studies on detection of alpha/beta radioactivity in foods revealed that diverse methods used by the Food Emergency Response Network (FERN) are deficient, and there is a compelling need to develop a simple, rapid, and versatile screening method for simultaneous detection of alpha/beta radioactivity in food.

Both liquid scintillation counting (LSC) and gas-flow proportional counting (GPC) techniques, in concert with proper sample preparation, can be used for the detection of alpha/beta radioactivity. Since many FERN radiological laboratories possess only one of these detection techniques, a simple yet versatile radiochemical procedure fitting both LSC and GPC measurements is highly preferable to fully leverage FERN radiological laboratory resources.

A radiochemical procedure applying rapid food ashing and batch extraction with DGA resin (N, N, N', N'-tetra-n-octyldiglycolamide, normal) was studied for simultaneous detection of ^{241}Am, ^{238}Pu, ^{239}Pu, ^{240}Pu, ^{241}Pu, ^{243}Cm, ^{244}Cm, and ^{90}Sr (via ^{90}Y). To enable LSC counting, the extracted analyte radionuclides were dissolved in 0.5M HCl and then mixed with Ultima Gold AB cocktail. For GPC counting, the extracted analyte radionuclides were dissolved in 1M HNO_3 and then evaporated to dryness on stainless steel planchet. ^{90}Y and ^{209}Po standard sources that match sample characteristics were used to calibrate LSC and GPC for alpha/beta counting efficiencies and percent spillovers.

The method applicability for triage of contaminated foods at levels of regulatory significance was demonstrated by analyzing different types of foods spiked with alpha/beta radionuclides of interest. The study showed that the method can detect ~0.6 Bq/kg of alpha radioactivity and ~0.4 Bq/kg of beta radioactivity based on analyzing 35 grams of food and counting sample for 1 hour. All analysis results were found to be within ±30 % of the known values.

In view of proven method performance, we detail the method development in the presentation, pointing out the merits of this method to enhance the FERN's radioanalytical capability and testing capacity for safeguarding the nation's food supply against radioactive contamination.