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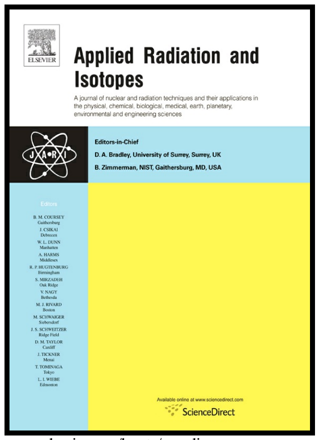

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Abdur-Rafay Shareef, Zhichao Lin, Kathryn Emanuele, Stephanie Healey, Patrick Regan, Brian Baker

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Abdur-Rafay Shareef*, Zhichao Lin, Kathryn Emanuele, Stephanie Healey, Patrick Regan, Brian Baker

Winchester Engineering and Analytical Center, Food and Drug Administration, 109 Holton Street, Winchester, MA 01890 USA

*Corresponding author.
E-mail address: Abdurrafay.Shareef@fda.hhs.gov

Highlights

- Picogram quantities of enriched uranium may be detected in complex food matrices
- Method does not require licensed radionuclide materials; non-radiochemical laboratories with ICP-MS experience may perform the method.
- Intended for use in the aftermath of a nuclear or radiological emergency involving enriched uranium.

Abstract

We have developed a quadrupole ICP-MS method for detecting sub-picogram quantities of ^{235}U in contaminated foods. Notable features included elimination of the requirement on possessing licensed nuclear materials so that non-radiochemical laboratories may perform this analysis in the event of a large-scale nuclear or radiological emergency calling for high sample surge capacity, elimination of several extremely hazardous reagents in sample analysis e.g. aqua regia and hydrofluoric acid, and the method was developed for applying a moderately priced, and widely used quadrupole inductively coupled plasma mass spectrometer (Q-ICP-MS). This method could be quickly implemented at many laboratories to increase emergency response capability.

Keywords

Enriched uranium, emergency response, quadrupole ICP-MS, food safety, isotopic ratio

Introduction

Our laboratory develops rapid and general methods for detecting radionuclides in food. Guiding principles are simplicity, improving the safety profile and reduction of environmental burden. In this communication we disclose the development of a method to detect the presence of enriched uranium in food through a simple $^{238}U/^{235}U$ isotopic ratio measurement. The natural isotopic ratio for uranium $^{238}U/^{235}U$ is 137.8 ± 2.3 (*k=2*) (Meija et al. 2016, Steiger and Jager 1977, and Richter et al. 2010). While enrichment of ^{235}U is useful for both energy and military applications, its release into the environment, accidental or intentional, will alter the natural $^{238}U/^{235}U$ ratio. Measuring the $^{238}U/^{235}U$ ratio in food provides a convenient and efficient way for screening and triaging food products free of enriched uranium and those requiring detailed follow up investigations. In the aftermath of a nuclear or radiological incident, analytical laboratories may be inundated with a large number and variety of food samples; the vast majorities are often not contaminated as shown by the results from monitoring foods during and after Chernobyl, Three Mile Island, and Fukushima nuclear power plant accidents. Sufficient analytical capacity does not exist to rigorously examine each sample, and therefore a simple and rapid