High Sensitivity, Nondestructive Determination of Toxic Trace Heavy Metals in Food by EDXRF Using a High Throughput Silicon Multi-Cathode Detector

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Food safety is a hot topic in today’s world. Toxic trace cadmium in food, for example, is of particular concern. Establishment of an international standard for toxic trace metals in food is now under way, administered mainly by the Codex Alimentarius Commission.

At present, the prevailing technologies for analyzing trace heavy metals in food includes inductive coupled plasma analysis and atomic absorption spectroscopy. These techniques, however, require destructive, time-consuming and expensive preprocessing of the samples, which makes routine high volume inspection impractical. Energy dispersive x-ray fluorescence (EDXRF) is an obvious choice for Cd analysis, but the Cd detection limit is only several ppm using conventional EDXRF, far above the 0.1 - 0.4 ppm level required for food analysis.

Recently, we have introduced a new detector – the Vortex-EX™ – into our EDXRF instrumentation, in conjunction with a novel system geometry that optimizes the solid angle of the detector and 50 W x-ray tube. The Vortex-EX™ incorporates a ~ 0.5 cm² silicon multi-cathode detector and offers very high throughput (up to 600 kcps) with superior energy resolution and peak stability over other types of x-ray detectors. Figure 1 shows the Cd spectra from three brown rice standards, using the new EDXRF instrumentation, showing the 1.82 ppm and 0.32 ppm Cd signals clearly identified. From these measurements, the calculated detection limit is 0.093 ppm for Cd. This new EDXRF instrumentation brings the detection of 0.1 – 0.4 ppm Cd into the practical realm, and could therefore enable a new standard for toxic metal monitoring in food, which would be nondestructive, fast and relatively inexpensive.

Figure 1. EDXRF analysis of brown rice standards. Calculated detection limit of Cd is 0.093 ppm. Live time = 420 s, Real time = 600 s.