TRACE ANALYSIS OF CADMIUM IN RICE BY THE SELECTIVE EXCITATION OF L SHELL X-RAY FLUORESCENCE

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Concentration of cadmium in the edible rice is strictly controlled in the sense of food safety. Among various analytical methods X-ray fluorescence (XRF) analysis is advantageous for the screening of the brown rice because of its strong elemental selectivity and nondestructiveness. Some of commercial XRF instruments have optimized condition for the K line analysis of cadmium, and the detection limit less than 1 ppm has been achieved. The common use of K shell excitation for the analysis of cadmium was originated from the interference of argon and potassium K lines with the cadmium L line. We have utilized the energy tunability of synchrotron radiation for the selective excitation of cadmium L lines in rice, and the optimization of the detection limit was investigated.

Polluted (Cd 1.82 ppm) and unpolluted (Cd 0.023 ppm) rice flours measured were certified reference materials No.10 from National Institute for Environmental Studies (NIES). The rice flour of 0.5 mg was fixed onto a 6μm polypropylene film, and a 20 wt% polyvinyl acetate aqueous solution of 20μl was used to fix the sample. Reference samples were commercial reagents of $CdBr_2$ and KCl and the mixture of them in BN matrix. Experiments were carried out on the BL-11 of HSRC [1], and the silicon drift detector (SDD) was used for the detection of XRF.

The selective excitation of cadmium L line could be achieved by employing the X-ray energy just above the L_3 –edge of cadmium, and the interference of potassium K line could be eliminated in principle. However, the contribution of the resonant inelastic X-ray scattering (RIXS) of potassium was not negligible because of the great abundance (ca. 2500 ppm) of potassium in rice. Though the amplitude of RIXS could be reduced by employing the incident x-ray energy far below the K absorption edge, the distribution of RIXS shifted to the lower energy side and the RIXS became the principal background in the region of the cadmium L line. The optimized detection limit was achieved with the excitation energy of 3580 eV, and the background was minimized. The detection limit of cadmium in rice was 0.34 ppm for data acquisition time of 5000 s.

[1] S. Hayakawa et al., Anal. Sci., 24, 835-837 (2008).