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Proficiency testing for measurement quality control of gamma ray spectrometry using brown rice.

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Content

Many laboratories measure radioactivity of Cs-134 and Cs-137 after the accident at Fukushima. It is effective for providing reliable results of measurement to grasp own measurement capability and improve it if any problem emerged through proficiency testing. In this study, to find out problems about the measurement and obtain the information which can be utilized for quality control, we carried out the proficiency testing. In the proficiency testing, we calculated the En value as an indication for laboratories which may have problem with their measurement. The signal in the En value is caused by (1) large difference between the reported and the reference value and (2) underestimation of uncertainty. We checked them at every report from the signaled laboratories. The proficiency testing was held in January 2015, and 145 laboratories reported 176 measurement results with their uncertainties. To find out problems of the measurement, we asked participants to report their measurement condition such as the sample density and correction factors. We showed participants how to estimate dominant uncertainties before the proficiency testing. The sample was brown rice harvested in Fukushima in 2011. We mixed and homogenized the samples adequately and filled them every 100 g in a bag to send. We filled 22 containers with the samples, and determined reference values by an HPGe detector. The reference values were obtained as 17.8±0.8 Bq kg-1 and 57.8±2.8 Bq kg-1 (k=2) for Cs-134 and Cs-137, respectively. The number of reports whose absolute value of the En value was bigger than 1 was 25 for Cs-134 or Cs-137 (Labtotal). 14 reports were signaled only for Cs-134 (Labcs-134), 6 were only for Cs-137(Labcs-137), and 5 for both nuclide (Labboth). Firstly, we reviewed the reported values in point of difference between the reported and the reference value. We checked whether Labtotal had biases on correction factors against other reports which were derived from a near degree of relative efficiency HPGe detector. Correction factors about the coincidence summing effect from Labcs-134 were normal against other reports. The self-absorption correction factors were also normal in the Labtotal. Evaluation procedure of these factors was declared on the domestic official guides in Japan. These results show that the evaluation of the correction factors leads to accurate analysis of radioactivity. Among Labboth, 3 laboratories reported their density filled in the container as bigger than 1 g cm-3. The filling density of grains such as brown rice seems to be about 0.9 g cm-3 in usual. We asked these laboratories to revise the density. As a result, the En values of 2 laboratories were improved. The results show that there were careless mistakes about evaluation of the mass quantity. Secondary, we reviewed the reported values in point of uncertainty. 5 reports among Labtotal, estimated smaller uncertainties than the sum of squares of itemized uncertainties. The En value of 2 of them would become less than 1 if their uncertainties were combined accurately. Uncertainties of 2 reports among Labtotal about statistics were obviously smaller than presumed from measurement time. An uncertainty about the calibration value was underestimated in 1 report among Labtotal. Uncertainties of 3 reports among Labtotal which reported no itemized uncertainties were obviously too small against other reports. These examples show that the skill to evaluate uncertainties should be improved. We found out issues to improve the measurement procedure and obtain the valuable information which can be utilized for the quality control from the result of the proficiency testing.

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