Concentration Coefficients of Radioiodine in Different Chemical Forms from Seawater to Fishery Products

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Abstract

Radioiodine takes various chemical forms in the environment. Ion forms of both I^- and IO_3^- were found in the ocean for ^{129}I discharged from the first Japanese commercial nuclear fuel reprocessing plant located in Rokkasho. Since the concentration factor of iodine from seawater to marine products strongly depends on the chemical form of iodine, it is necessary for realistic assessment of radiation dose from the discharged radioiodine via marine products to use the concentration factor of each chemical form of iodine. This study aims to establish the concentration factor of radioiodine in I^- and IO_3^- for marine products (seaweed, shellfish and benthos). In FY 2014, 1) the concentration factors of I^- and IO_3^- for shellfish (abalone, *Haliotis discus hannai*) were measured using an iodine radiotracer and 2) the chemical form of stable iodine in abalone was analyzed by using X-ray absorption fine structure (XAFS) analysis.

The abalone samples were exposed to $^{125}I^-$ or $^{125}IO_3^-$ in seawater using air-tight chambers. Exposures to ^{125}I were carried out for 24, 48 and 72 h. Three abalone samples were used for each exposure, after which each was dissected to obtain muscle and hepatopancreas tissues. The tissue samples were measured for ^{125}I concentration by using a NaI detector. The seawater in the chamber was also collected at the time of abalone sampling, and $^{125}I^-$ and $^{125}IO_3^-$ in it were separated by an anion exchange column followed by the radioactivity measurement. Concentration of ^{125}I in both kinds of tissues was monotonically increased during the expose and did not reach the equilibrium condition with that in seawater. Therefore, only the transfer rate constant of $^{125}I^-$ or $^{125}IO_3^-$ from seawater into each tissue was obtained by fitting experimental data to a compartment model, under the assumption that excretion rate constant from abalone into seawater was negligibly small. Excretion rate constant from the tissues to seawater was obtained by using the stable iodine concentration in seawater and the tissues under the assumption that the stable iodine concentration did not depend on the iodine in the food which abalone consume. The results showed that the concentration factor of $^{125}I^-$ to muscle tissue was comparable with that of $^{125}IO_3^-$. The concentration factor of $^{125}I^-$ to hepatopancreas tissue was twice that of muscle tissue, and that of $^{125}IO_3^-$ was quite small.

The analysis of chemical forms of stable iodine in hepatopancreas tissue of abalone samples by XAFS showed that most of the iodine in this tissue was in an organic iodine form similar to seaweeds which are the primary food for abalone.

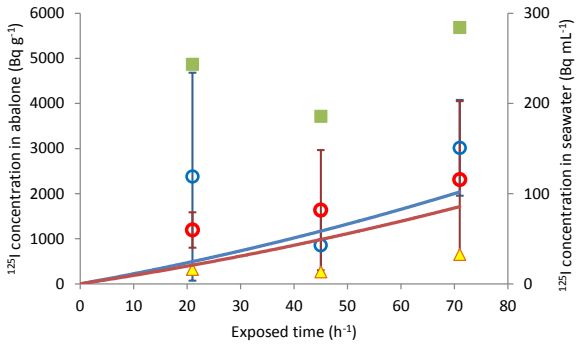

Fig. 1 Measured ^{125}I concentration in abalone and seawater during $^{125}I^-$ exposure. Open blue circles and open red circles show ^{125}I concentrations in abalone muscle and hepatopancreas, respectively. Solid blue and red lines show estimated concentrations in muscle and hepatopancreas, respectively. Green solid squares and yellow solid triangles show concentrations of $^{125}I^-$ and $^{125}IO_3^-$ in seawater, respectively.

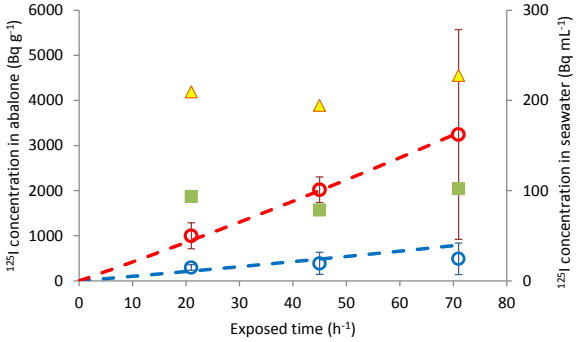

Fig. 2 Measured ^{125}I concentration in abalone and seawater during $^{125}IO_3^-$ exposure. Open blue circles and open red circles show ^{125}I concentrations in abalone muscle and hepatopancreas, respectively. Dashed blue and red lines show estimated concentrations in muscle and hepatopancreas, respectively. Green solid squares and yellow solid triangles show concentrations of $^{125}I^-$ and $^{125}IO_3^-$ in seawater, respectively.

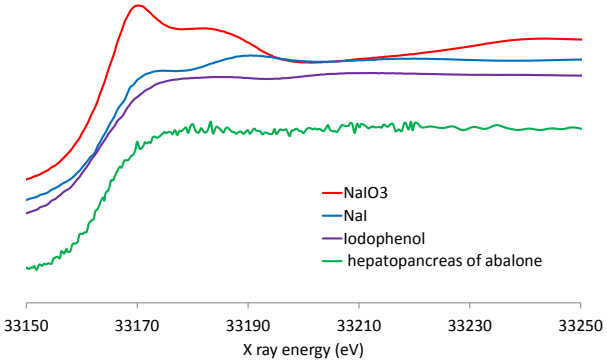

Fig. 3 Measured XAFS spectrums of $NaIO_3$, NaI, indophenol, and hepatopancreas of abalone.