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

Toshihiro SHIBATA, Yuichi TAKAKU, and Shun'ichi HISAMATSU
Department of Radioecology

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 to use the concentration factor of each chemical form of iodine for realistic assessment of radiation dose from the discharged radioiodine via marine products. This study aims to establish the concentration factor of radioiodine in I^- and IO_3^- for marine products (seaweed, shellfish and benthos). In FY 2013, the concentration coefficients of I^- and IO_3^- for brown algae (*Sargassum horneri*) were measured using an iodine radiotracer and the chemical form of stable iodine in *S. horneri* was analyzed by using X-ray absorption fine structure (XAFS) analysis.

The concentration factor of I^- or IO_3^- for *S. horneri* was measured with ^{125}I radiotracer. The seaweed samples were incubated for 7 d in the seawater with added $^{125}I^-$ or $^{125}IO_3^-$. The biological activity of the seaweed samples was checked by their ^{13}C absorption. The total ^{125}I and $^{125}I^-$ concentrations in seawater were monitored during the incubation. The difference between the total ^{125}I and $^{125}I^-$ concentrations was assumed as $^{125}IO_3^-$ concentration. Iodine-125 concentration in *S. horneri* was almost saturated after 3 d exposure. The rate constant of $^{125}I^-$ or $^{125}IO_3^-$ transfer from seawater into *S. horneri* and the transfer constant of ^{125}I from *S. horneri* into seawater were obtained by fitting experimental data to a compartment model with three compartments: ^{125}I in *S. horneri*, $^{125}I^-$ and $^{125}IO_3^-$ in seawater. Organic ^{125}I, which was possibly synthesized by the seaweed, was included in the $^{125}IO_3^-$ fraction in seawater but neglected here. However, the fitting result showed that organic ^{125}I should be considered to obtain an accurate rate constant.

The analysis of chemical forms of stable iodine in *S. horneri* samples by XAFS showed that most of the iodine in *S. horneri* was in organic iodine. A sample of *S. horneri* incubated in seawater with added I^- (iodine concentration of 2.5 mg L^{-1}), was also analyzed and no significantly different chemical form from the natural one was found.

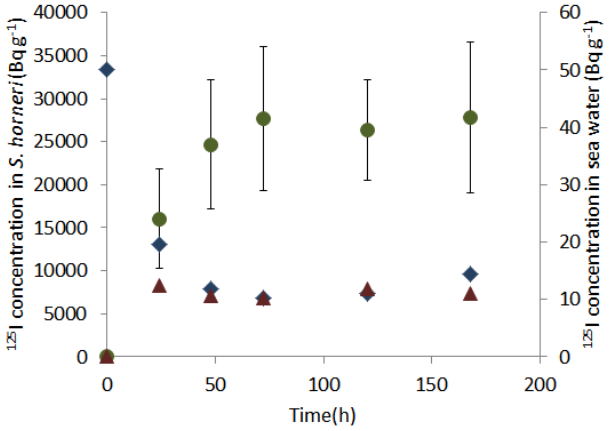

Fig. 1 Measured ^{125}I concentration in *S. horneri* and seawater after adding $^{125}I^-$ to the cultivation system. Solid circles show ^{125}I concentration in *S. horneri*, and solid squares and triangles show concentrations of $^{125}I^-$ and $^{125}IO_3^-$ in seawater, respectively.

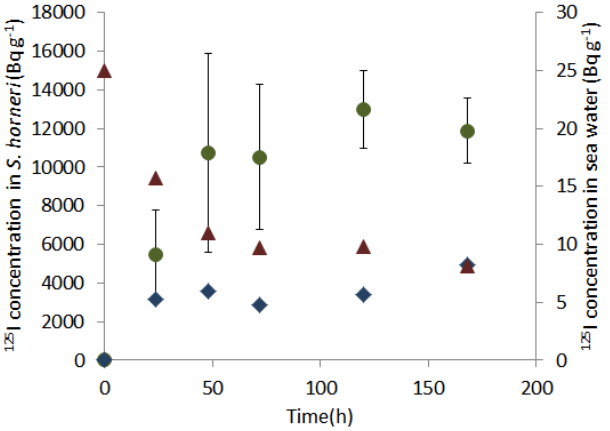

Fig. 2 Measured iodine concentrations in *S. horneri* and seawater after adding $^{125}IO_3^-$ to the cultivation system. Solid circles show radioiodine concentration in *S. horneri*, and solid squares and triangles show concentrations of $^{125}I^-$ and $^{125}IO_3^-$ in seawater, respectively.

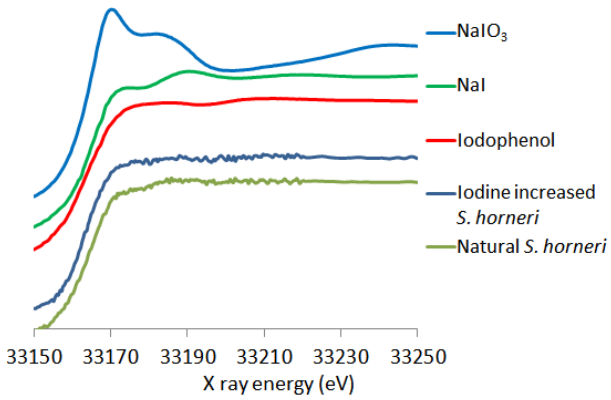

Fig. 3 Measured XAFS spectra of $NaIO_3$, NaI, indophenol, *S. horneri* incubated in seawater with elevated I^- concentration and natural *S. horneri*.