# Radioisotope Research Facility

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## General Summary

The Radioisotope Research Facility was established to support medical and biological research with radioisotopes. The Facility also accepts nonradioisotopic research. We have supported researchers by suggesting methods and practical techniques for experiments. Lectures and training courses were held for researchers and for medical students and graduate students. In 2011, 35 researchers from 14 departments and 14 students of 2 curriculums used the laboratory of this facility. Major nuclides used for experiments were $^{32}$P, $^{51}$Cr, $^{125}$I, $^{35}$S, and $^{3}$H.

## Research Activities

*The active site of exfoliative toxin A of Staphylococcus aureus*
The exfoliative toxin (ET) produced by *S. aureus* causes staphylococcal scalded-skin syndrome. To determine the biologically active site of ETA, we introduced mutations into specific Tyr residues of the *eta* gene using site-directed *in-vitro* mutagenesis. The mutant plasmids were used to express cETA in *E. coli* C6008S. While the exfoliative activity in neonatal mice and the antigenic activity of native cETA were as high as those of sETA produced by *S. aureus*, the cETAs of the Tyr mutant showed decreased toxicity and immunoreactivity, except for Tyr-161. Replacement of Tyr-17-18 or Tyr-225-232Tyr-41-43 of cETA led to complete loss of toxicity and immunoreactivity. These results suggest that this cluster of Tyr residues is essential for the toxicity and immunoreactivity of ETA.

*Development of techniques for determining radioactivity*
Radon is the second most common cause, after smoking, of lung cancer in the general population. Liquid scintillation counting has been a standard method for measuring radon in air and water. We have reported the determination of radon in water and air samples using a methylphenyl silicone oil scintillator. Radon in water was extracted with the silicone oil scintillator and with a toluene scintillator. A silicone rubber scintillator has been made from the materials KER-6150-A and B (Shin-etsu Chemical Co., Ltd., Tokyo, Japan) to determine the radon concentration in air. The silicone rubber scintillator is transparent, flexible, water-resistant, heat-resistant, and cold-resistant.

*Analysis of resistance mechanisms in radiation-resistant organisms*
Tardigrades show remarkable adaptability in extreme environmental conditions, such as high radiation, high temperature, and high pressure. Tardigrades isolated from activated sludge were identified with 18S ribosomal DNA as being of the genus *Isohypsibius*. Tardigrades stained with a fluorescent probe (CellTracker Green CMFDA, Molecular Probes,

Life Technologies Corp., Carlsbad, CA) were irradiated with $^{60}$Co with doses of 500, 1,000, 2,000, 4,000, and 7,000 Gy at the Takasaki Advanced Radiation Research Institute (Takasaki, Gunma Prefecture). When tardigrades were not stained, survival rates with doses of 1,000 Gy or less were as high as those without radiation. However, tardigrades that were stained had much lower survival rates after being irradiated with low doses. These results suggest that fluorescent staining has a radiosensitizing effect on *Isohypsibius*.

*Radioactive fallout in the environment*

Radioactive materials from the accident at the Fukushima Dai-ichi Nuclear Power Plant spread as far as the Kanto area. More than 70 soil samples were collected from April through November 2011 in the Kanto area. Leaves (pine, Japanese cedar, cypress, and bamboo) and bamboo shoots were also examined with radiation images using an imaging plate system. Cesium-134 and cesium-137 were detected in all samples, and iodine-131 was detected in some samples. At the time of sampling the concentrations of cesium-134 and cesium-137 in soil samples in the Kanto area ranged from 0.4 to 100 kBq/m$^2$ and from 0.5 to 130 kBq/m$^2$, respectively.

## Publications

***Shinji H, Yosizawa Y, Tajima A, Iwase T, Sugimoto S, Seki K, Mizunoe Y.*** Role of fibronectin-binding proteins A and B in in vitro cellular infections and in vivo septic infections by Staphylococcus aureus. *Infect Immun.* 2011; **79:** 2215-23.

### Reviews and Books

***Yoshizawa Y, Minowa H, Takiue M.*** Determination of radon using silicone oil scintillator. In: Cassette P, editor. LSC 2010: Advances in liquid scintillation spectrometry. Tucson: Radiocarbon; 2011. p. 273-7.