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 non-radioisotopic research. We have supported researchers by suggesting methods and practical techniques for experiments. Lectures and training courses are held for researchers and for medical students and graduate students. In 2012, 35 researchers from 12 departments and 13 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.
The Fukushima Dai-ichi Nuclear Power Plant was damaged by the Tohoku–Pacific Ocean Earthquake and Tsunami on March 11, 2011. Large amounts of fission products and activation products were released into the environment by the accident. We focus on the study of the behavior and distribution of the radioactive materials in the environment as well as on radiation biology. Education related to radiation is also an interest.

Research Activities

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. Soil and plant samples were examined with radiation images using an imaging plate system.

Imaging data of a bamboo shoot in Kawamata-machi, Fukushima Prefecture, from June 2011 suggest that its contamination by ^{134}Cs and ^{137}Cs was caused not by extraneous attachment but by absorption through roots or the translocation from leaves. Radioactive cesium uptake into the plant body was present in high concentrations in the edible parts of the bamboo shoot, especially at the tip. We will continue to collect imaging data in the same bamboo grove to obtain more information on annual trends and the circulation of radioactive cesium in the bamboo forest.

Radiation images of leaves show small particles with high radioactivity. These radioactive particles had moved little from the initial site of adhesion despite repeated exposure to rain. Particulate contamination was distributed only in the bottom leaves that had opened before the accident and was not seen in the top leaves that grew after the accident. This finding confirms that particulate deposition on the leaves and the bark would remain for several years and that concentrations of radiocesium in whole leaves would decrease as new leaves grow.

Analysis of resistance mechanism in radiation resistant organisms

Tardigrades are small 8-legged animals less than 1 mm in length. They are commonly called water bears because of the way the walk slowly in water like bears. Water bears

are tolerant to ionizing radiation. They inhabit environments ranging from the deep sea to the land. Activated sludge was obtained from the Ariake Water Reclamation Center, Bureau of Sewerage, Tokyo Metropolitan Government, to clarify the radiation-resistant mechanism of water bears in the sludge. DNA-based identification of the water bears in the activated sludge revealed that only those of the genus *Isohypsibius* were present.
Isohypsibius was exposed to ionizing radiation using the cobalt-60 irradiation equipment at Takasaki Advanced Radiation Research Institute, Japan Atomic Energy Agency. The absorbed dose range for the irradiation was 5, 2, 1, and 0.5 kGy with 0 kGy as a negative control. The results show that *Isohypsibius* was tolerant to the dose of 2 kGy but that a dose of 5 kGy was fatal. A fluorescence dye, CellTracker Green CMFDA (Lonza Walkersville, Inc., Walkersville, MD, USA), affects the radiosensitivity of water bears. Therefore, CellTracker was added at concentration of 1 μM to the culture solution of *Isohypsibius,* which was then irradiated with doses of 375, 250, and 125 Gy using an X-radiation device (MBR-1520R, Hitachi Medico, Tokyo, Japan). The presence of CellTracker increased the radiosensitivity of *Isohypsibius* such that the dose of 250 Gy was fatal.

Study of products containing radioactive materials of natural origin
We have developed a silicone oil scintillator to measure radon in air and water. Radon is a chemically inert, naturally occurring radioactive gas that emanates from rocks and soils. The World Health Organization has proposed a reference level of 100 Bq/m^3 in 2009 for the purpose of controlling lung cancer caused by radon gas. Under the prevailing country-specific conditions, the chosen reference level should not exceed 300 Bq/m^3, which represents a biological dose equivalent of approximately 10 mSv per year. Uranium and thorium concentrations in the soil are relatively low in Japan, and the indoor radon density in most houses is less than 100 Bq/m^3. However, there are bath additives that contain radioactive materials marketed as so-called “radon hot spring.” These radioactive materials of natural origin are regulated by “guidelines for the safety management of naturally occurring radioactive materials including uranium or thorium.” Therefore, we attempted qualitative and quantitative analyses of the “thoron hot spring” manufactured with a radioactive hot spring–making device using amang (tin tailing) that contains thorium. The peaks of ^{232}Th and ^{224}Ra were confirmed by the measurement of alpha-rays using a liquid scintillation counter (LSC-6100, Aloka, Tokyo, Japan). On the other hand, the presence of ^{212}Pb (239 keV) and ^{228}Ac (338 keV) was confirmed by the measurement of gamma-rays. The radioactivity of these substances was lower enough than 1 Bq/g, which is the upper limit for regulation in the guidelines.