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 the nonradioisotopic research that uses animals or recombinant DNA techniques. 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 2013, 33 researchers from 11 departments and 18 students of 2 curriculums used the laboratory in this facility. Major nuclides used for experiments were ^{32}P, ^{51}Cr, ^{125}I, ^{14}C, 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

Analysis of resistance mechanisms in radiation-resistant organisms
Tardigrades are small water-dwelling animals less than 1 mm in length. They are commonly called water bears because they walk slowly with 8 legs. They have adapted to growth at low temperatures and are found in Antarctica and the Himalayas, but they also inhabit moss in cities. Water bears can tolerate extreme environments, including ionizing radiation. To clarify the radiation-resistant mechanism of the water bear by transcriptome analysis and whole genome DNA sequencing, activated sludge was obtained from Ariake Water Reclamation Center, Bureau of Sewerage, Tokyo Metropolitan Government, to isolate the sludge water bear *Isohypsibius*. Nucleic acids were isolated from *Isohypsibius* and analyzed with a next-generation DNA sequencer. The results showed that samples from the sludge water bear were heavily contaminated with the nucleic acids of eukaryotic microbes. Therefore, we changed the sample with DNA of *Milnesium tardigradum* isolated from the moss *Brachymenium exile*. However, isolating enough *M. tardigradum* specimens for DNA preparation was difficult. The DNA prepared from *M. tardigradum* was amplified with the whole-genome amplification method. From 2 separate preparations, a total of 0.3 μg of DNA was obtained with multiple annealing and looping-based amplification cycles. The DNA size was 1 to 1.5 kbp, which is compatible with the next-generation sequence analysis.

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 June 2011 collected from Kawamata-cho, Fukushima Prefecture, suggest that its contamination by ^{134}Cs and ^{137}Cs was caused not by extraneous attachment but by absorption through roots or translocation from leaves. Radioactive cesium taken up into the plant body was present in high concentrations in the edible parts of the bamboo shoot, especially at the tip. We collected samples from the same bamboo grove for 3 years to obtain more information on annual trends and the circulation of radioactive cesium in the bamboo forest. The concentration of ^{137}Cs was measured as 2,600 Bq/kg in 2011, 600 to 900 Bq/kg in 2012, and 190 Bq/kg in 2013. Therefore, the amount of new radiocesium uptake is very small. Radiocesium was quantitatively measured in seawater collected from the Fukushima coast. The surface seawater was sampled about 1.5 km off the coast of the Fukushima Daiichi nuclear power plant in November 2013. Radioactive cesium was measured with the ammonium molybdophosphate method and gamma-ray spectrometry using a Ge-detector. The ^{137}Cs concentration was 0.02 to 0.08 Bq/L, and the ^{134}Cs concentration was 0.01 to 0.04 Bq/L. The ^{137}Cs concentration has not returned to the level of 0.001 Bq/L before the accident but has been significantly decreased from the level of several thousand Bq/L immediately after the accident, and the risk of migration to marine organisms from seawater need not be considered.

Study of radon

Radon is produced from the natural radioactive decay of uranium that exists in rocks and soil. Airborne radon activity is the second most common cause of lung cancer after smoking. However, in Japan, radon thermae or hot springs are popular for those who expect radiation hormesis. Radon is a chemically inert gas that can escape easily from the bath water into the air. The gas tends to concentrate in enclosed spaces, such as bathrooms. To assess the radon concentration of hot springs, the radon components must be measured repeatedly because it is affected by several factors, such as the uranium concentration in the basement, the underground structure, and atmospheric pressure. Samples were collected from 2 famous radon hot springs: Misasa Onsen (Misasa, Tohaku-gun, Tottori Prefecture) and Sarugajo Onsen (Tarumizu, Kagoshima Prefecture). The radon concentrations of the hot springs, measured with a liquid scintillation counter, were 1,070 Bq/L and 1,470 Bq/L, respectively. The radon concentration of air in these hot springs may exceed 100 Bq/m^3, which is the reference level proposed by the World Health Organization because the estimated transfer coefficient of radon between water and air is 1.0×10^{-4}.