

Radioisotope Research Facility

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General Summary

The Radioisotope Research Facility was established to support medical and biological research with isotopes. We have supported researchers by suggesting methods and practical techniques for experiments. Lectures and training are held for researchers and for medical students and graduate students who are starting to work with radioisotopes. In 2007, 66 researchers in 15 departments consulted this facility for 29 studies. On March 19, the facility passed an inspection by the Nuclear Safety Technology Center. This inspection confirmed that the facility is maintained in compliance with technical standards and that the radiation control was appropriately performed.

Research Activities

Isolation of fibronectin binding protein — deficient mutants of Staphylococcus aureus
Staphylococcus aureus has a variety of adhesins on its cell surface. Among these proteins, fibronectin binding proteins (FnBPs) are crucial for interacting with host cells. We isolated FnBP A-deficient mutants by inserting a tetracycline-resistance gene into the *fnb A* gene. The mutant strain and the parental SH1000 strain were used to infect mice, and the virulence of the strains was determined. The results indicate the importance of FnBP A for invading host tissues. To determine the role of FnBP B in *in vivo* infection, we are attempting to isolate *fnb B* gene mutants.

The synergistic activity of glycopeptides with beta-lactams against methicillin-resistant S. aureus

Glycopeptide antibiotics inhibit peptidoglycan synthesis by binding to the terminal D-Ala-D-Ala stem of peptidoglycan precursors. Although a synergistic effect is expected when the glycopeptides are combined with beta-lactams, which inhibit cell wall synthetic enzymes, 3 kinds of results — synergistic, no change, and antagonistic — are obtained. Cefpirome and ceftizoxime, which show antagonistic effects against vancomycin, have low affinity for penicillin binding protein (PBP) 3 and PBP4, whereas imipenem and panipenem, which show synergistic effects, have high affinity for all 4 PBPs. The ability of the beta-lactams to inhibit PBP1 — PBP4 is essential for the synergistic effect.

Analysis of the mechanism of resistance in radiation-resistant organisms

Tardigrades (water bears) are highly resistant to radiation, but the mechanism of resistance remains unclear. Therefore, we have isolated tardigrades from mosses grown on the streets around The Jikei University and examined their resistance to dehydration, temperature, and radiation of the tardigrades of the family *Macrobiotidae* and *Milnesium*

tardigradum, identified on the basis of morphologic features.

A study of radioactivity in consumer products

We have measured gamma rays emitted from deodorants that are said to have “minus-ion” effects. The results revealed that these products contain the daughter nuclides of the Th and U series as well as ^{40}K . Three deodorants were likely to be radioactive consumer products through the intentional addition of radioactivity. One cupboard deodorant had a relatively high whole-body dosage of $0.17 \mu \text{ Sv}\cdot\text{h}^{-1}$ at the distance of 1 m.

Radon gas is the most important risk factor for lung cancer. The ^{222}Rn concentrations emanating from the “minus-ion” wallpapers were measured using Pico-Rad radon detectors (AccuStar Labs, Medway, MA, USA). The maximum radon concentration was $34 \text{ Bq}\cdot\text{m}^{-3}$, which was twice the average indoor value of $15.6 \text{ Bq}\cdot\text{m}^{-3}$. We believe that wallpaper that emits radioactivity can unnecessarily increase indoor radon exposure.

Research on marine bacteria

The habitat distribution of several marine bacteria was surveyed during *Tansei Maru* cruise KT-07-16. To study the metallic transport system of microbes, we focused on marine bacteria that produce siderophores in a low-iron environment. We are attempting to cultivate such bacteria from seawater and the sediment of the sea floor at a depth of 3,000 m.

Publications

Minowa H, Takeda M¹, Ebihara M¹ (1Tokyo Metropolitan Univ). Sequential determination of ultra-trace highly siderophile elements and rare earth elements by radiochemical neutron activation analysis: application to pallasite meteorites. *J Radioanal Nuclear Chem* 2007; **272**: 321-5.
Furuta E, Yokota S, Aburai T, Yoshizawa Y. Evaluation of radiation exposure from shoe-

deodorants as radioactive consumer products (in Japanese). *RADIOISOTOPES*. 2007; **56**: 443-53.

Furuta E, Moriata-Murase Y, Yoshizawa Y. Evaluation of internal/external exposure from interior building materials (in Japanese). *Hoken-buturi* 2007; **42**: 341-8.