The interaction of Ce^{144} with mussels and green crabs

by

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In the investigations on the radiocontamination of marine environment considerable interest has been centred on the interaction of fission products with marine biota. Most of the published data in this field have been summarized by POLIKARPOV [1966]. The earlier published data showed that several rare earths, namely Ce^{144}, Pm^{147}, Eu^{155}, usually occur as radioactive wastes in the sea environment [OSTERBERG *et al.*, 1963; CAREY *et al.*, 1966; BERNHARD, 1967; CERRAI *et al.*, 1967] and HIYAMA & SHIMIZU [1964] showed the interaction of Ce^{144} with some marine organisms. The concentration of stable rare earths in sea water was well investigated by BOWEN *et al.*, [1968], while POPOV [1968] reported the physico-chemical state of Ce^{144} in sea water. The physiological function of cerium in marine organisms is practically unknown.

In our experiments we investigated the uptake, loss and distribution of Ce^{144} in various organs and tissues of mussels (*Mytilus galloprovincialis* Lam.) and crabs (*Carcinus mediterraneus* Czrn.) from the Adriatic coastal area in the vicinity of Rovinj. At the same time the effect of EDTA (disodium ethylene diamine tetraacetic dihydrate) on the uptake of Ce^{144} was investigated too.

The animals were adapted to the laboratory conditions in 10 liter plastic basins containing filtered sea water (temperature 23 $\pm$ 3° C, salinity about 37 p. 1000, oxygen saturated). After the equilibrium of Ce^{144} exchange between the sea water and the basin's wall was reached (carrier free Ce^{144} in 1 N HCl, 3 μC/l of the sea water), the animals were introduced into the basin. At previously fixed intervals the radioactivity of the animals and basin samples was determined by a gamma scintillation counter. In experiments with EDTA 100 mg of EDTA was used per liter of the sea water. The loss of the Ce^{144} from animals was followed in non-radioactive running sea water.

The uptake of radionuclide by the animals was expressed as contamination factor (animal/environment activity ratio per unit weight), while the loss was expressed as percentage of the initial activity.

The uptake of Ce^{144} in various organs and tissues of mussels is presented in Fig. 1. Very high contamination factor (5800) for byssus was observed, most probably due to the adsorption of the particular fraction of the radionuclide on the large surface of this organ. Therefore the relatively high contamination factor for the " remaining edible part " (400) might also be due to the surface contamination of the digestive tract. The results of loss experiment performed after 25 days contamination (Fig. 2) show that after the fifth day the digestive tract is almost decontaminated, while the gills, muscles, byssus and shells keep still about 40 p. 100 of Ce^{144} they originally had.

The uptake of Ce^{144} by coastal crab was followed during 25 days. The contamination factors vary very much, although the relative distribution of the activity in tissues and organs remains always the same, what might be due to the physical and chemical changes of Ce^{144} [POLIKARPOV, 1961]. The highest contamination factors were found in gills (616), skeleton (118) and " remaining part " (59), while in other tissues and organs they were considerably lower (muscles : 10, hepatopancreas : 13, digestive tract : 21, reproductive organs : 7, hemolymph : 1).

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The effect of EDTA upon the accumulation of Ce^{144} was significant for both animals. In relation to the control animals, EDTA inhibited the Ce^{144} accumulation by 90 p. 100 in mussels, and to somewhat lesser degrees in crabs.

These results as well as those of our previous work [LUCU et *al.*, 1969] indicate that radionuclides occurring in sea water in particulate form are mostly bound to byssus, shell and digestive tract. Activation analysis showed also that cerium is located only in byssus and shell [STROHAL *et al.*, 1969]. This could explain our contamination factors and the found decontamination processes, and suggests adsorption as the most probable way of radiocontamination with Ce^{144} in the investigated organisms.

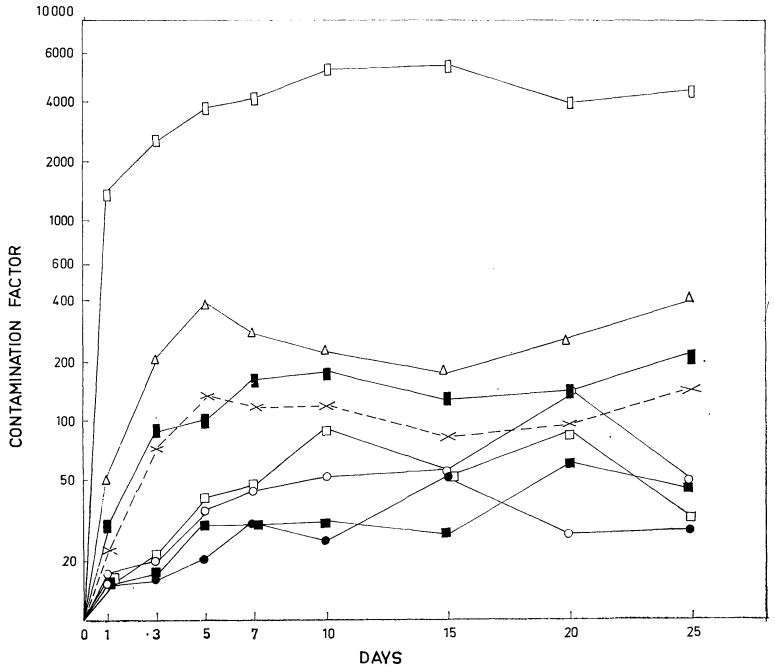

FIG. 1. — *Mytilus galloprovincialis.* Uptake of Ce^{144} in byssus (open rectangle), shell (solid rectangle), gills (open circles), muscle (solid circles), mantle (solid squares), foot (open squares), residual edible part (open triangles), total edible part (crosses) during the 25 days contamination.

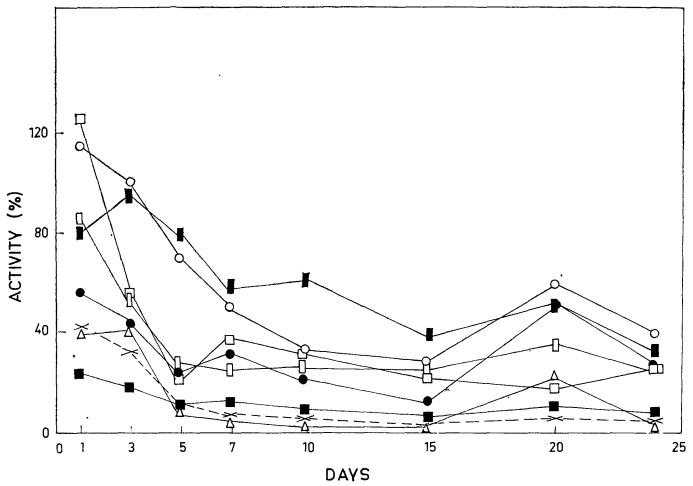

FIG. 2. — *Mytilus galloprovincialis.* Loss of Ce^{144} in the byssus (open rectangle), shell (solid rectangle), gills (open circles), muscle (solid circles), mantle (solid squares), foot (open squares), residual edible part (open triangles), total edible part (crosses, during the 25 days decontamination.

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