Effect of different radiotracer labelling techniques on radionuclide excretion rates in marine organisms*

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Abstract

Experiments were designed to assess the effect of different techniques of radiotracer labelling on subsequent radioisotope excretion rates in marine organisms. Results indicate that ^{65}Zn excretion rates in amphipods and shrimp are strongly dependent upon the manner in which the organisms accumulate the radiotracer.

Résumé

Des expériences ont été faites pour voir si des techniques différentes de marquage par un traceur radioactif peuvent affecter son élimination ultérieure par des organismes marins. Les résultats indiquent que les taux d'excrétion du ^{65}Zn chez les amphipodes et les crevettes dépendent beaucoup de la manière dont ces organismes accumulent le radiotraceur.

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Estimates of radionuclide turnover times derived from laboratory experiments are important parameters for accurate assessment of how aquatic biota accumulate, retain and distribute radionuclides under natural conditions. Furthermore, radiotracers are increasingly being used in laboratory and field studies to measure the flux rates of the corresponding metals. The question arises whether the many different laboratory labelling techniques lead to the same result as far as radionuclide or metal flux is concerned, and whether these results truly reflect excretion rates that would occur under natural conditions. To this end, a series of experiments were designed to test the effects of different techniques of radiotracer labelling on subsequent ^{65}Zn excretion rates in two marine crustaceans.

In the first experiment, an assemblage of mussels with its associated biotic community including the amphipod, *Gammarus locusta*, was collected and placed in an outdoor simulated ecosystem which contained 300 l of ^{65}Zn-labelled sea water. The amphipods accumulated ^{65}Zn from water and their normal food under what was considered to be a close approximation to a natural mode of labelling. To compare other modes of radioisotope administration normally used in the laboratory, amphipods of simi-

* Le texte *in extenso* de cette communication a paru *in : Marine Biology*, **30**, pp. 297-304 (1975).

Rapp. Comm. int. Mer Médit., **23**, 7, pp. 125-126 (1976).

lar size were allowed to accumulate ^{65}Zn using four different combinations of labelled food and water. After a one month accumulation period, ^{65}Zn excretion from each group of amphipods was measured over a period of several months.

Unfortunately, only one amphipod was retrieved from the outdoor tank at the termination of uptake. This individual excreted ^{65}Zn at a nearly perfect single exponential rate with a biological half-time of 15 days. Although no significant differences in ^{65}Zn excretion rates were evident among the four groups labelled in the laboratory, excretion appeared to take place from two or more compartments within the animals with biological half-times of the slow, exponential compartment ranging from 58 to 75 days. Hence, because of the multiphasic nature of ^{65}Zn excretion displayed by the laboratory-labelled amphipods, a completely different interpretation of the data would have resulted had the experiment been terminated one month after the beginning of loss. The results demonstrate that various laboratory-labelling techniques can give comparable results; however, vastly different excretion kinetics may be expected when organisms such as amphipods accumulate the isotope under near natural conditions.

In a second experiment using the shrimp, *Lysmata seticaudata*, three groups were labelled in the laboratory under the following conditions : one group receiving ^{65}Zn from food and water for six months, a second absorbing the tracer from water for 25 days, and a third receiving a single ration of ^{65}Zn-labelled *Artemia*. Excretion rates in all three groups during the first two months were quite different; the fastest rate in those receiving one ration of labelled food and the slowest in those maintained in the radioactive medium for six months. These differences were probably a reflection of the degree to which the various compartments with slow zinc turnover times had equilibrated with ^{65}Zn during uptake. After several months the excretion rates for all three groups were quite similar ($Tb\frac{1}{2}$ = 75-102 days), probably reflecting excretion from a similar zinc pool. However, depending upon the treatment, the percentages of total ^{65}Zn contained in this pool varied between 2 and 16 %.

The results of the study emphasize the necessity for achieving isotopic equilibrium in the animal's metal pools when using ^{65}Zn to measure the kinetics of stable zinc. Short-term uptake or inadequate labelling techniques resulting in a low degree of isotopic equilibration will lead to an underestimate of the importance of zinc flux from pools slow turnover rates. To accurately assess total zinc flux in marine organisms, excretion experiments should be continued for a sufficiently long time to ensure that ^{65}Zn is virtually exhausted from all labelled zinc pools. In the case of small marine crustaceans the necessary time appears to be on the order of months.