LEAD BIOACCUMULATION IN THE MEDITERRANEAN MUSSEL *MYTILUS GALLOPROVINCIALIS*

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Abstract

Uptake and loss kinetics of waterborne Pb, using radiotracer ^{210}Pb, were investigated in the mussel *Mytilus galloprovincialis*. Pb was readily taken up (concentration factor up to 300 after 14 days of exposure) and was relatively strongly retained (biological half-life: 23-28 days). Bioconcentration and retention efficiency of Pb in the mussel tissues were found to be independent of its ambient dissolved concentrations.

Keywords : Bio-accumulation, Bio-indicators, Bivalves, Lead.

Introduction

Among metal contaminants, Pb is an element of particular concern due to its widespread occurrence in the marine environment and its well-documented toxicity for biota [1,2].

Although severely regulated in the industrialised countries, global emissions do not show a significant downward trend and Pb will continue to cause problems [3,4]. It is thus important to develop tools to monitor its occurrence and abundance in coastal waters, particularly in less-developed regions of the world where the legislation on its uses and disposal are often weakly enforced.

Bivalve molluscs, particularly the genus *Mytilus*, are well known to bioaccumulate metals up to several orders of magnitude with respect to the levels found in their environment and to fulfill the additional criteria as being ideal biomonitors since they are sedentary and easy to sample [5,6]. The aim of this work was to investigate Pb bioaccumulation using ^{210}Pb radiotracer under controlled laboratory conditions in a widely distributed and abundant mussel species along the Mediterranean coasts, *viz. Mytilus galloprovincialis*, and to evaluate its potential as a bioindicator species to be considered for biomonitoring Pb contamination in the coastal marine environment of North Africa.

Material and methods

In order to minimize the effect that size (age) may exert on metal concentrations, 40 specimens of *Mytilus galloprovincialis* of uniform size (30-35 mm length; 5.0-6.5 g wet wt) were collected in Corsica in September 2002. Upon return to the laboratory, the shells of the mussels were cleansed and tagged and animals were then acclimated for two weeks under laboratory conditions (temperature 19°C; salinity 37 p.s.u.).

After acclimation, the mussels were exposed for 14 days to 4 different concentrations of waterborne ^{210}Pb (0.25, 0.5, 1.25 and 2.5 Bq ml^{-1}). Each specimen was gamma-counted on a daily basis using a NaI detector to determine ^{210}Pb uptake kinetics. In order to ensure a constant ^{210}Pb activity in each of the 4 aquaria, the seawater and the radioactive spike were renewed each day; seawater samples were collected and gamma-counted before and after each seawater renewal.

Following the uptake phase, organisms were dissected in order to assess the body partitioning of the radioactivity and the remaining animals were placed into running-seawater aquaria for 22 days in order to study their depuration kinetics.

Results and Discussion

The results of the seawater exposure experiments indicate that *M. galloprovincialis* readily took up ^{210}Pb according to a linear uptake-kinetic model (Fig. 1a). Uptake efficiency (with respect to the dissolved ^{210}Pb concentration in the surrounding seawater) was similar (p = 0.35) for the 4 exposure conditions (0.25 to 2.5 Bq ^{210}Pb ml^{-1}). At the end of the exposure period (14 days), calculated concentration factors for the different exposure conditions reached values ranging between 210 and 300.

Following the exposure period, non-contaminated conditions were restored (clean flowing sea water) for 22 days and loss of ^{210}Pb from mussel tissues was determined (depuration phase) during that time.

M. galloprovincialis was found to eliminate ^{210}Pb according to mono-exponential loss kinetics (Fig. 1b). Mussels displayed similar loss kinetics (p = 0.25) regardless the ^{210}Pb activity (0.25 to 2.5 Bq ml^{-1}) to which they were previously exposed: the estimated biological half-life ($Tb_{1/2}$) of ^{210}Pb ranged between 23 and 28 d.

The experimental results presented here indicate that *M. galloprovincialis* bioconcentrates waterborne Pb efficiently in its tissues, and that concentration factors are independent of the dissolved metal concentration in the seawater, i.e. bioconcentration of Pb in the mussel tissues is proportional to the metal concentration in the surrounding seawater. The mussel also displayed a relatively long retention time of incorporated Pb ($Tb_{1/2}$ from 23 to 28 days), and the elimination kinetics in relative units are independent of the dissolved ^{210}Pb concentration in the environment.

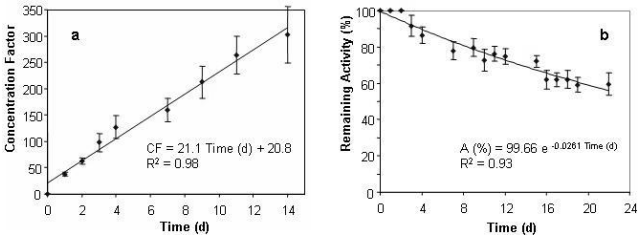

Fig. 1. Uptake (a) and loss (b) kinetics of ^{210}Pb in *Mytilus galloprovincialis* exposed to 0.25 Bq ^{210}Pb ml^{-1} via sea water (n = 5).

These findings are very promising as they indicate that the Pb concentration in the edible tissues of *M. galloprovincialis* would actually reflect the Pb contamination level in its environment, and that this bivalve would be able to preserve the information related to contamination events for several weeks in its tissues.

The results of our experimental work strongly support the usefulness of *M.galloprovincialis* as an excellent bioindicator species for Pb contamination monitoring in North African waters.

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