Turkish J. Mar. Sci.2: 171-175 (1996)

ACCUMULATION OF ARSENIC IN GOBY FISH (Proterorhinus marmorathus) AND THE EFFECT OF DETERGENT ON THE ACCUMULATION

KAYA BALIĞINDA (Proterorhinus marmorathus) ARSENİK BİRİKİMİ VE BU BİRİKİME DETERJAN ETKİSİ

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Key words: Arsenic, accumulation, goby fish, detergent.

Abstract

In this study, the accumulation of arsenic was investigated in goby fish from water pathway under laboratory conditions. The bioaccumulation rate of ^{74}As was found to be relatively slow. The pattern of accumulation results represented by a equation of $C_t=0.23\ (1-e^{-0.1104t})$. The effect of the LAS on the arsenic accumulation was also ivestigated and the result showed that the LAS had no effect significantly.

Introduction

Nowadays, the problems of heavy metal pollution in aquatic environment and its effect on the human health draw increasing attention. The toxic metal arsenic is introduced through direct discharge of industrial waste into the sea or through rivers.

In litterature, lot of papers have been published on arsenic concentrations in marine organisms. At the same time, several investigations have been carried out on arsenic levels in fish collected from the Black Sea coast of Turkey (Topcuoğlu et al.,1990 ;1995) Arsenic in marine organisms is present is primarily in organic form (Lunde, 1977; Penrose et al.,1977).

The behaviour of arsenic in aquatic environment have been studied by many researchers. In many studies, the radiotracer experiment were designed to study the effects of some environmental and biological parameters on arsenic accumulation and elimination processes in marine organims (Fowler and Ünlü, 1978; Ünlü and Fowler, 1979; Ünlü,1979).

All aquatic organisms are exposed to the mixture of many pollutants in nature. It is therefore, important to establish which pollutants interfere with each other and the way they intensify and reduce their effects on the organims involved. However, little

information is known about pollutant interactions in marine environment.Topcuoğlu and Birol (1982) has shown that Linear alkylbenzenesulfonate (LAS) caused significant increase in zinc accumulation by goby fish in compared with the control group, during the uptake period.LAS is a major anionic surfactant material used in large volume by detergent industry.

The present study examines the arsenic accumulation by goby fish with and without exposed to the LAS during acclimation period.

Materials and Methods

The goby fish (*Proterorhinus marmorathus* PALL.) was collected from the Küçükçekmece Lagoon (brackish water) in Istanbul.The mean wet weight of the fish was 2.41± 0.36 g and similar sized animals were selected.They were acclimated to laboratory conditions by holding infiberglass tanks. During the acclimation periods the animals were divided two groups.One group of fish was exposed to 4 ppm LAS for 12 days.Each group consisted of 10 animals and was kept in the experimental basin containing 6 liter unfiltered lagoon water.The water in the basins was changed once in every two days to keep of the LAS solution at constant level.

Following the acclimation, each individual was placed in a plastic jar cotaining 1 liter cotton-filtered lagoon water into wich 37 kBq liter^{-1} of ^{74}As was added. Arsenic-74 ($T_{1/2}$=17.7 days, 2500 mCi ^{74}As per mg stable arsenic) was used sodium arsenate. The ^{74}As in all samples was measured using a multi-channel analyzer coupled to 7.6 x 7.6 cm well-type NaI (Tl) crystal. An internal reference standard of the ^{74}As was used to correct for the different counting geometries and physical decay during the counting of the samples.The bioaccumulation of ^{74}As 30 days and during that time the radioactive media were changed every 2 days in order to maintain the activity concentration at costant level. on days when the media had been changed, the fish were fed in non-radioactive water containing fish meat for approximately 1 h. The other procedures in the accumulation experiment were similar to those of previously described work (Topcuoğlu et al.,1987). During the experiment the salinity and temperature of the water were 8.09 ± 0.75 % and 15 ± 2 ^{o}C, respectively.

Results and Discussion

The results of the bioaccumulation of ^{74}As in goby fish with and without exposed to the LAS are shown in Fig. 1.The concentration factor of 0.23 at equilibrium was calculated for control group and no significant effect of LAS has been observed on this bioaccumulation process.The concentration factor values in the control group may be expressed as a linear differential equation with constant coefficient:

$$C_t = C_{SS} \ (1 - e^{-kt})$$

where $C_t$is the concentration factor at time t, C_{SS} is the concentration factor at steady state and k is the biological elimination rate constant. The bioaccumulation data will be fitted to the equation of,

$$C_t = 0.23\ (1 - e^{-0.1104t})$$

from this equation, the respective biological half-life of arsenic was calculated to be 6 days.

The accumulation rate of inorganic arsenic form as arsenat from water pathway by goby fish appears to be relatively slow process. At the same time, the concentration factor are very low (<1) and no strongly influenced by LAS.However, high arsenic concentration has been reported as 76 mg g^{-1} dry weight in some benthic fish (Topcuoğlu et al.,1990).Our result indicate that such level would be difficult to reach by accumulation of arsenic from water pathway only.The chemical form of the arsenic in marine organisms was found mainly as organic form. From this reason,the food pathway of arsenic accumulation in fish is very important than that from the water pathway.This hypothesis was in agreement with arsenic found primarily in organic form in shrimp after accumulation from food pathway(Fowler and Ünlü, 1978). In the same study, indicated that accumulated arsenic as arsenate form from water pathway remains in an inorganic form.

The effect of the detergent on the accumulation of arsenic may be depend of LAS concentration in experimental media or the loss rate of LAS in the fish.In previous studies, the biological half-life was calculated to be as 35 hours in same fish species(Topcuoğlu and Birol, 1982).The anionic detergent in the Küçükçekmece Lake was measured as 5.5 ppm as the highest concentration(Topcuoğlu et al.,1992). On the other hand, the toxic effect of LAS was studied in larvae of the goby fish and LC_{50} value was found to be 4 ppm(Ünlü and Topcuoğlu, 1977).

From data obtained with the goby fish, it can be said that we need more valuable data on the interaction of pollutants in marine environment.

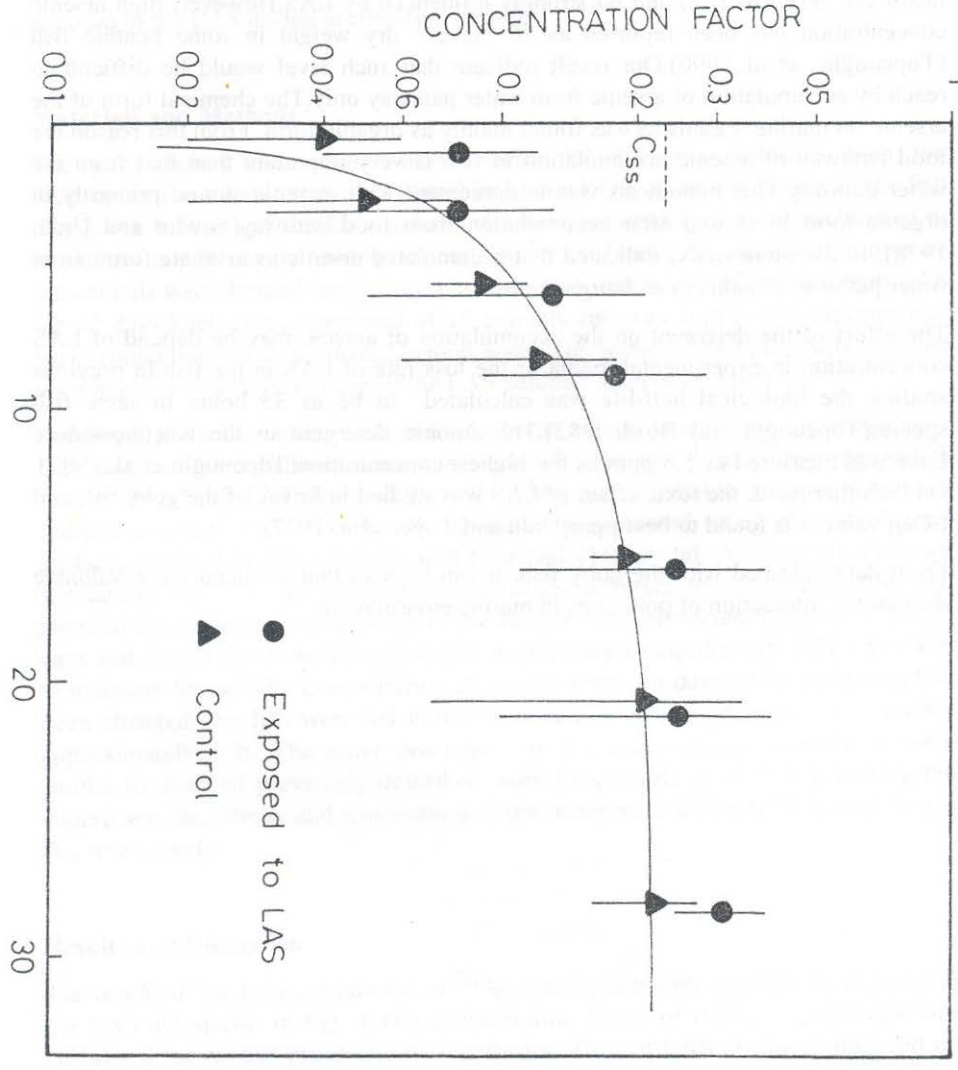

Fig. 1. Accumulation of ^{74}As in goby fish.

Özet

Arseniğin kaya balığında sudan olan biyobirikiminin incelendiği bu çalışmada, ayrıca deterjan aktif maddesi olan LAS'ın da bu birikime etkisi olup olmadığı araştırılmıştır. Birikim bulgularının $C_t = 0.23\ (1\text{-}e^{-0.1104t})$ eşitliği ile verildiği bu araştırmada, biyobirikim oldukça düşük düzeyde bulunmuştur. Diğer taraftan LAS'ın biyobirikim üzerinde anlamlı bir etkisi saptanmamıştır.

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Recieved 3.6.1996
Accepted 5.8.1996