R-II3

Incorporation of Tc-95m in the brown Macroalgae Fucus serratus and Fucus spiralis under different experimental conditions

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ABSTRACT

Laboratory experiments with two macroalgae, collected along the Belgian and Dutch coasts, have shown that the concentration of technetium (Tc-95m) was increased in light and decreased in darkness. Moreover, it was lower at 4°C than at 21°C. In addition, inactivation of the algae at 50°C strongly inhibited technetium uptake.

INTRODUCTION

Radiochemical analyses of Tc-99 content of natural samples and laboratory experiments with Tc-95m have revealed that, among brown marine algae, some species belonging to the Fucales (Ascophyllum nodosum, Fucus serratus, Fucus spiralis and Fucus vesiculosus) show concentration factors (CFs) attaining 50,000 (see literature in Bonotto et al., 1988). The high CFs observed for Tc-99 under natural conditions might result from an integrated accumulation process, the algae being exposed to low levels of this radionuclide for quite a long time (up to a few years). Moreover, environmental and biological factors are thought to play an important role in the uptake, distribution and metabolism of technetium in marine algae. It was, thus, of interest to investigate the effect of light, darkness and temperature as well as the influence of the physiological conditions of the algae on the concentration of technetium. This paper reports results obtained with the species Fucus serratus and Fucus spiralis.

RESULTS AND DISCUSSION

The uptake of Tc-95m by both species of Fucus was found to be dependent on light and temperature. In Fucus serratus, the amount of Tc-95m taken up in darkness was only one fifth of that incorporated under light conditions. Moreover, in algae kept at 4°C, a strong reduction (about 70%) of technetium fixation was observed in short-term experiments (up to 6 hours). In addition, heat inactivated algae incorporated only 0.3% of the activity measured in the normal ones. Nevertheless, it has been possible to visualize by autoradiography the localization of Tc-95m in inactivated algae, by exposing them to an X-ray film for several days (fig.1). This result shows that in heat inactivated algae, like in the normal ones, Tc-95m is heterogeneously distributed, being more concentrated in some apical regions, probably because the inactivation was not complete. Scanning electron microscopy (SEM) of the surface of Fucus spiralis has shown that the cells were covered by an organic coating, which might bind some radionuclides. It was reported, in fact, that adsorption of americium (Am-243) occurs in the thin outer organic coating of the related species Fucus vesiculosus (Carvalho and Fowler, 1985). Although the experimental evidence accumulated till now suggests that Tc-95m uptake in Fucus serratus and Fucus spiralis is controlled by physiological processes, a limited surface adsorption of this radionuclide might occur.

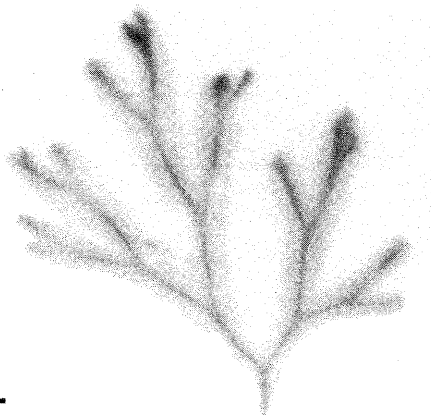

Fig.1.
Autoradiograph of Fucus serratus inactivated in sea water at 50°C (according to Topcuoğlu and Fowler, 1984) before to be supplied with Tc-95m and processed for autoradiography (according to Bonotto et al., 1986). Due to the very low incorporation, the alga was exposed to an X-ray film during 5 days. Note the more intense labeling of the midribs and of some apical regions. Scale = 1 cm.

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R-II4

The effect of temperature on Mercury toxicity in the Mussel Mytilus galloprovincialis

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ABSTRACT. The effect of temperature on the toxicity of mercury in Mytilus galloprovincialis collected from the shore of Bosporus, Turkey, was studied in experimental aquaria using Hg-203 as tracer. Results are referring to the experiments done in October and February in sea water temperature 22 and 15 Celsius respectively. An inverse ratio was found concerning the survival of mussels exposed to the mercury toxicity and the water temperature influence.

INTRODUCTION. Mercury is a heavy metal introduced in the environment as a waste product due to the developing industry and technology. Mercury toxic effects in organisms have reached dangerous levels in certain cases (1,2). It has been reported that season and temperature variations are functional parameters in the bioaccumulation of mercury by various organisms (3).

EXPERIMENTAL. Mytilus galloprovincialis specimens (about 60 mm length), collected from Yenikoy shore of Bosporus (Istanbul, Turkey), were used for the experiments performed in October and February, in sea water temperature 22 and 15 Celsius respectively. 0.2 mg/l of sublethal quantity HgCl2 (24 uCi/l Hg-203) were introduced into the experimental aquaria at both temperatures.

RESULTS AND DISCUSSION. The experimental data of this work referring to the radioactivity percentage and death ratio for M. galloprovincialis exposed to Hg-203 at 15 and 22 Celsius are presented in TABLE 1.

Biological accumulation is either directly or indirectly depended on the species of the organisms, the physicochemical characteristics of the contaminating substance and the physical condition of the medium (4). The effect of temperature and mercury concentration on the average survival of the mussel Mytilus edulis has been investigated (3). The average survival of mussels in a mercury dose 2.5 mg/l, when the animals were kept at 16 Celsius was found to be 5.0 days, while for mussels exposed to the same dose but kept at 20 Celsius, a lower value 3.1 days was observed. These results are in accordance with the ours given in TABLE 1, where an inverse ratio in the survival of the mussels exposed to mercury toxicity and the water temperature influence can be postulated.

TABLE 1. Radioactivity percentage in water (A/ml) and death ratio of mussels

	OCTOBER						FEBRUARY					
	22 C			15 C			22 C			15 C		
		S.M.			S.M.			S.M.			S.M.	
Days	A/ml (%)	E.	C.	A/ml (%)	E.	C.	A/ml (%)	E.	C.	A/ml (%)	E.	C.
1	100	28	10	100	7	7	100	10	10	100	7	7
2	76	27	10	28	7	7	33	10	10	36	7	7
3	58	14	10	17	7	7	18	10	10	20	7	7
4	44	4	10	13	7	7	16	10	10	15	7	7
7	2	1	10	9	7	7	13	2	10	10	7	7
8	2	-	10	8	7	7	7	1	10	9	7	7
9	-	-	10	6	7	7	6	-	10	7	7	7
11	-	-	10	5	7	7	-	-	10	5	7	7
15	-	-	10	5	7	7	-	-	10	4	7	7
18	-	-	10	3	7	7	-	-	10	3	7	7
24	-	-	10	3	7	7	-	-	10	3	7	7

(S.M.): Number of survived mussels
(E.): Experimental
(C.): Control

Mussels, in order to meet oxygen and nutrition requirements, use higher amount of water during their muscle movement. Thus mercury concentration in their organism is increased at higher temperatures. In relation to this phenomenon, the distribution rate of mercury taken up by the mussels increases due to the enhanced metabolic activity at high temperature and therefore the toxic effects are displayed faster.

From the data reported in litterature and the results of our experiments it can be concluded that the temperature is an important factor in the attainment of mercury toxic effect in the organism.

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