NEW RESULTS CONCERNING ACCUMULATION RATE OF METALS IN ALGAE CYSTOSEIRA BARBATA AND IN ALGINATE

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Abstract

New results concerning Cu, Zn, Cd, Pb accumulation rate in algae and alginate extracted from algae Cystoseira barbata collected in March 2012 from Mangalia, located in the southern part of the Romanian Black Sea coast, are reported. The patterns of heavy metal accumulations rates of contaminated algae and alginate extracted from contaminated algae, in increments, were for algae Zn < Cd < Cu < Pb and for alginate Pb < Cd < Cu < Zn.

Keywords: Algae, Black Sea, Metals

Introduction

The ecosystem of the Romanian Black Sea coast has been damaged as a result of metal contamination. Marine algae are frequently used as biological indicator of heavy metal pollution [1]. The results of heavy metal accumulation in algae of the Romanian Black Sea coast are reported [2]. Brown algae are known to have high concentration of alginates, which is extracted and largely exploited in various domains. Evaluation of metal accumulation rate in alginates isolated from contaminated algae is highly important, considering the diversified usage of alginates in food industry and medicine. No studies have been carried out in Romania concerning heavy metal accumulation in alginates extracted from contaminated algae, correlated with contamination rate of algae with metals.

The aim of this study was to determine the accumulations rates of Cu, Cd, Zn, and Pb in algae Cystoseira barbata and in the alginate extracted from the contaminated algae.

Materials and methods

Samples of algae Cystoseira barbata have been collected in March 2012 from Mangalia Gulf, located in the southern part of the Romanian coast. The accumulations rates of Cu, Cd, Zn, and Pb in algae Cystoseira barbata were realized by means of contamination procedure of algae with metals. Batch contamination experiments of algae were carried out using the following materials: fresh biomass, contaminated sea water with heavy metal ions such as Cu (I), Cd (II), Zn (II), Pb (II) (60mg/L for each metal). Alginates were extracted from contaminated algae by a specific method [3]. The algae and alginate have been prepared (washed, dried) and subjected to dissolution with nitric acid and hydrogen peroxide in a Digeshdal device. Metal concentrations were determined by atomic absorption spectrophotometer (GBC Avanta). The accumulation rate of heavy metals in fresh algae was calculated considering the initial concentration of this metals in algae (uncontaminated). Analyses were made three times in the same conditions and the mean values were reported.

Results and discussion

Results obtained in this experiment are shown in Table 1.

Tab. 1. The metal concentration and accumulation rates in algae and alginate

<table>
<thead>
<tr>
<th></th>
<th>Cu</th>
<th>Zn</th>
<th>Cd</th>
<th>Pb</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean</td>
<td>5.72 ± 0.38a</td>
<td>26.00 ± 2.95a</td>
<td>0.95 ± 0.07a</td>
<td>7.73 ± 1.40a</td>
</tr>
<tr>
<td>165.00 ± 34.35a</td>
<td>107.35 ± 8.45a</td>
<td>185.50 ± 13.74a</td>
<td>1206 ± 233.00a</td>
<td></td>
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</tbody>
</table>

The mean metal concentration in uncontaminated algae and contaminated algae (mg/Kg dry wt)

The accumulations rate of metal ions in algae and alginate were calculated considering the initial concentration of this metals in algae (uncontaminated). Analyses were made three times in the same conditions and the mean values were reported.

Results obtained in this experiment are shown in Table 1.

The mean metal concentration in uncontaminated algae and contaminated algae (mg/Kg dry wt)

The mean metal concentration in uncontaminated and contaminated alginate (mg/Kg dry wt)

The accumulations rate of metal ions in algae and alginate were calculated considering the initial concentration of this metals in algae (uncontaminated). Analyses were made three times in the same conditions and the mean values were reported.

In a study of Chirila et al (2006) the heavy metals concentrations in the algae Cystoseira barbata collected from Romanian coast of the Black Sea were higher than the concentrations obtained for uncontaminated algae of our study (2012) [4]. Cystoseira barbata is a biological indicator of heavy metal pollution and our results obtained for the uncontaminated algae suggests that pollution rate on the Romanian Black Sea coast decreased at the end of the period 2006 – 2012. Zn and Pb concentrations were higher than Cd and Cu in uncontaminated algae probably because of sulphur water springs existing in the Mangalia gulf coastal area. Concentrations of metals were higher in contaminated algae and alginate than concentrations found in uncontaminated algae and alginate. On the other hand, Pb accumulation rate was higher in algae and lower in alginate and Zn accumulation rate was lower in algae and higher in alginate. The lead is a toxic metal for human body and our results showed that the accumulation rate of Pb in alginate extracted from contaminated algae was lower than contaminated algae (0.19 versus 66.5). This fact is very important for human health.

Conclusions

Accumulation rates of the heavy metals in algae and alginate increases as follows: for algae Zn < Cd < Cu < Pb and for alginate Pb < Cd < Cu < Zn. It is very important for human health that accumulation rate of Pb in alginate extracted from contaminated algae to be lower versus contaminated algae. There is no evidence in current literature to confirm or invalidate the results obtained through this experiment, regarding accumulation rate of metals in alginate extracted from contaminated algae.

References