

HEAVY METAL CONTENTS IN *MYTILUS GALLOPROVINCIALIS* FROM BOKA KOTORSKA BAY, ADRIATIC SEA

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Abstract

Contents of two essential, Cu and Zn, and three toxic metals, Hg, Pb and Cd, were determined in mussel samples collected in the Boka Kotorska Bay, Montenegro, in order to evaluate their levels in different locations and seasons in this important area of Montenegro. The obtained results were compared with their maximum allowable concentrations (MAC), as well as with results that were obtained in *Mytilus galloprovincialis* in other areas of Adriatic Sea.

Keywords: Metals, Bio-indicators, South Adriatic Sea

Introduction

During the last decades human activities have led to increased concentrations of heavy metals in the marine environment. Although these elements occur naturally and some of them are essential in small quantities, at higher concentrations they can be toxic to organisms [1]. On the other hand, non-essential metals, such as Hg, Pb and Cd, are very toxic even at low concentrations. Mussels *Mytilus galloprovincialis* are known as bioindicators of marine pollution since, as sedentary, filter-feeding animals, they accumulate heavy metals present in water [2]. Having in mind that Montenegrin coastal area receives a heavy influx of sewage and industrial effluents, as well as domestic and agricultural wastes, and considering the fact that mussels are consumed as a food, the determination of the levels of potentially toxic metals in mussels is very important [3].

Material and methods

Fresh mussels were taken from three locations, which present different levels and sources of human impact in the Boka Kotorska Bay. Sampling was performed in the fall of 2014 and spring of 2015 at two locations in Kotor Bay, IMB and COGIMAR (Ljuta), and at one open sea location, near the Žanjice beach. Mussels were dissected by removing the bysiss and shells. After that soft tissue was dried, homogenized and digested with HNO₃ and H₂O₂ in closed vessel microwave digestion system under high temperature and pressure (Ethos 1). Concentrations of Cu, Zn, Pb and Cd were determined by inductively coupled plasma-optical emission spectrometer (ICP-OES, Spectro Arcos) and Hg was determined by Direct Mercury Analyzer (Milestone, DMA-80). In order to validate the method for accuracy, also certified reference material (NIST 2976) was analyzed.

Results and discussion

The highest heavy metal contents were mostly at Žanjice, especially in the fall, except for the Pb, which was higher at IMB in the fall and also at COGIMAR in both, fall and spring, and in the spring Cd was the highest at COGIMAR. Žanjice is a beach near the open sea, but with a lot of cottages and restaurants, with a discharge of wastewater directly into the sea. This is especially increased during summer tourist season, when there is also a problem of recreational activities. We didn't find significant differences in heavy metals concentrations between the investigated seasons, although there were some variations. The most considerable difference was found for Cu contents, which were lower at all locations in the spring. Comparing the obtained results with maximum allowable concentrations (MAC) for certain trace elements, it was found that the metal contents in mussels from Boka Kotorska Bay were mostly lower than permitted limits for *M. galloprovincialis* [4]. Only mussel samples from COGIMAR in the spring (224.4 mg/kg) and from Žanjice in the fall (239.6 mg/kg) and spring (225.6 mg/kg), were found to contain Zn above limits. Also Hg in mussels from Žanjice in the fall (0.31 mg/kg) and from COGIMAR in the spring (0.27 mg/kg) was above the limit. However, the results are within the range of values commonly found in other areas of Adriatic Sea (Table 1).

Tab. 1. The concentration of heavy metals (mg/kg) in mussels from the Adriatic coast

Location	Cu	Zn	Pb	Cd	Hg
SE Adriatic, Albania ^[5]	4.61–28.9	59.8–244.6	1.39–5.69	0.27–0.77	0.08–0.42
E Adriatic, Croatia ^[6]	1.98–11.0	49.4–418.3	0.24–3.69	0.39–2.40	0.08–0.28
SW Adriatic, Italy ^[1]	4.66–19.2	/	0.37–3.25	0.38–1.84	0.10–0.81
MAC ^[4]	10	200	3.2	3.7	0.23
SE Adriatic, Montenegro (This study)	2.52–8.04	105.0–239.6	1.26–2.02	1.20–2.62	0.13–0.31

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