TRACE METALS IN BIVALVES' SOFT TISSUE FROM MLJET NATIONAL PARK AQUATORIUM, CROATIA

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Abstract

Preliminary study of bivalves' soft tissue exposure to trace metals (Cd, Pb, Cu and Zn) from water column in the Mljet NP, was done. Elevated trace metal concentrations in water column and bivalves were observed in semi-enclosed saline lakes. Determined concentrations were most likely from the natural source, taking into account hydrogeological characteristics of the investigated area.

Keywords: Adriatic Sea, Metals, Bivalves

INTRODUCTION

Mljet NP is part of the Mljet island in Croatian Southern Adriatic with two connected saline lakes as its main water body (Fig. 1). Veliko Jezero (VJ) and Malo Jezero (MJ) lakes were developed in Mesozoic limestones and dolomites, which are semi-enclosed and connected to the open sea by narrow channel. It is very important to highlight that dolomitic rocks can contain elevated concentrations of Zn, Pb and especially Cd [1]. For metals determination composite soft tissue samples of nearly equal bivalves length were prepared, as accumulation of metals is connected with biotic and abiotic factors governed by their size and age [2]. Metals concentrations were measured by differential pulse anodic stripping voltammetry (DPASV).

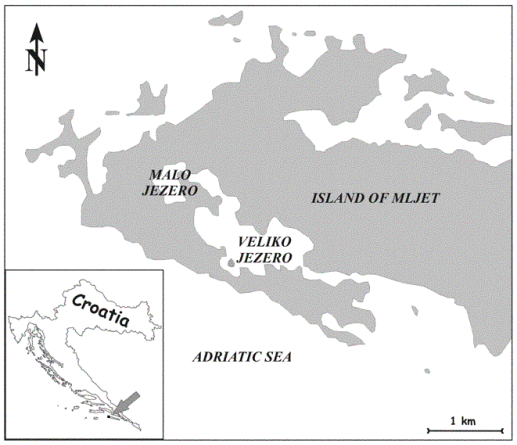

Fig. 1. Mljet National Park map

RESULTS AND DISCUSSION

Bivalves' samples were taken from Malo jezero lake, Veliko jezero lake and open sea coastal area. Bivalves investigated were: *Arca noae, Mytilus galloprovincialis, Modiolus barbatus and Ostrea edulis*. There are major differences in the uptake rate of dissolved metals among different species of bivalves [3]. E.g. scallops and oysters have the highest uptake rate constants for different metals as result of their high pumping rates. Within Malo Jezero lake underwater karstic spring (freshwater efflux by dolomite rocks leaching and soil weathering, showed high metal concentrations) is located. Karstic spring input raised metal concentrations in waters of the National park water body [4]. Therefore, metal concentrations (Zn, Pb and especially Cd) in the water column and in bivalves, were over expected values. Most interesting were Cd concentrations in tissues of *Modiolus barbatus and Ostrea edulis* that were over 1 mg/kg wet weight in all investigated Mljet water bodies (MJ and VJ) (Table 1). Considering the National bylaw on toxins, metals, metaloids and other harmfull substances in food, maximum allowed values of Cd in the tissue of shellfish is 1 mg/kg, while in *Ostrea edulis* 1.68±0.09 mg/kg in MJ and 0.37±0.03 mg/kg in VJ, were found. In *Mytilus gal.* and *Arca noae* were below 1 mg/kg due to different metabolism of these bivalves [3]. Cd dissolved concentrations in the Mljet NP lakes were enhanced due to input of its considerable amounts through the karstic spring and dissolved cadmium concentrations in Mljet NP water body were: MJ (near karstic spring) 18.7±1.4 ng L^{-1}, in VJ 12.0±0.6 ng L^{-1} and in the open Adriatic sea 6.4±0.9 ng L^{-1}. All metal concentrations in bivalves were given as mass in wet weight.

Zn, Pb and Cu concentrations in composite bivalve soft tissue samples are shown in Table 1. As an example, metals concentrationsin *Ostrea edulis* were found to be: Zn 1322±39 mg/kg in MJ and 251.3±8.8 mg/kg in VJ; Cu 34±1.26 mg/kg in MJ and 26.41±3.01 mg/kg in VJ; Pb 0.22±0.04 mg/kg in MJ and 0.10±0.01 mg/kg in VJ (all mass concentrations are in wet weight). In the water column of all Mljet NP water bodies concentrations of these metals were enhanced, especially after heavy rainfalls. The lack of anthropogenic influence on the lakes metal concentrations, suggested natural sourcing of these elements into the lakes. It should be taken into account that Cd is present in the water column mostly in dissolved form, appropriate for accumulation in bivalves. Zinc and copper were partly adsorbed onto particles but still in significant amount as dissolved and available for accumulation by bivalves. Pb is adsorbed the most onto particles and its concentration in bivalves' soft tissue was lowest.

This study showed, unequivocally, the suitability of bivalves as metal biomonitors, as metal concentrations are not necessarily elevated due to anthropogenic activities. Unexpectedly high metal concentrations (cadmium the most) in the water column and bivalves originated from dolomite rocks and was brought to waters by leaching and soil weathering during rainfalls. Enhanced cadmium level in bivalves over allowed concentrations regulated by national bylaw on harmful substances in food, was determined to originate from natural source, dolomite rocks leaching, in the first place.

Tab. 1. Metal concentrations in bivalves soft tissues (expressed in ug/g wet weight) sampled in aquatorium of National Park Mljet

	Bivalves	Zn	Cd	Pb	Cu
Open sea	*Arca noae*	18.3±1.4	0.31±0.00	0.14±0.02	0.57±0.04
	Mytilus gal.	28.8±2.1	0.63±0.05	0.24±0.03	1.32±0.06
Veliko jezero	*Arca noae*	34.2±0.5	0.32±0.01	0.12±0.01	2.7±0.2
	Mytilus gal.	25.7±2.5	0.26±0.04	0.15±0.02	0.94±0.06
	Ostrea edulis	251.3±8.8	0.37±0.03	0.10±0.01	26.41±3.01
Malo jezero	*Arca noae*	27.3±2.0	0.58±0.02	0.14±0.01	1.18±0.12
	Mytilus gal.	29.8±1.4	0.56±0.03	0.17±0.01	0.93±0.07
	Modiolus barbatus	70.5±6.4	2.73±0.30	0.65±0.05	3.12±0.24
	Ostrea edulis	1322±39	1.68±0.09	0.22±0.04	34.57±1.26

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