THE PRESENCE OF ZINC IN MUSCLE TISSUE OF PRUSSIAN CARP AND BREAM IN THE GRUŽA AND BOVAN RESERVOIRS

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PRISUSTVO CINKA U MIŠIĆNOM TKIVU BABUŠKE I DEVERIKE U AKUMULACIJAMA GRUŽA I BOVAN

Apstrakt

Zagađenje slatkovodnih ekosistema širokim spektrom zagađivača postalo je veoma važno pitanje u poslednjih nekoliko decenija, ne samo zbog uticaj na vodosnabdevanje, već i zbog štete koju nanosi vodenim organizmima. Smatra se da su metali najvažniji oblik zagađenja voda zbog toksičnosti, perzistentnosti i akumulacije u vodenim organizmima. Vodeni organizmi su u širokoj upotrebi biološkog monitoringa promena nivoa antropogenih zagađujućih materija. Poznavanje koncentracije metala u ribama je važno kako za pravilno planiranje upravljanja vodama tako i u pogledu ljudske ishrane. Zn je esencijalni metal i kao takav igra važnu ulogu u biološkim sistemima, ali takođe prekomernim unosom može proizvesti toksičan efekat.

Akumulacije Gruža i Bovan su formirane osamdesetih godina za vodosnabdevanje, ali su danas i značajne ribolovne vode. Antropogeni uticaj na ove akumulacije je vrlo izražen. Konstantno je direktno ispuštanje neprečišćenih otpadnih voda, okolno zemljište se intenzivno obrađuje uz primenu invazivnih agrotehničkih mera (prekomerna upotreba pesticida, herbicida i fungicida), ali i širenje vikend naselja koja uglavnom nemaju regulisano skladištenje i ispuštanje otpadnih voda.

Babuška (*Carassius gibelio*) i deverika (*Abramis brama*) su prikupljene iz akumulacija Gruža i Bovan, a uzorci mišićnog tkiva su analizirani na prisustvo cinka (Zn) kako bismo utvrdili da li postoji razlika u akumulaciji ovog metala u mišićnom tkivu između ove dve vrste, kao i između iste vrste u dve različite akumulacije. Koncentracija Zn u mišićnom tkivu babuške je bila znatno veća nego u mićnom tkivu deverike u obe akumulacije, ali nije postojala bitna razlika u koncentracijama između dve akumulacije. Koncentracija cinka u mišićima obe vrste u obe akumulacije je na prihvatljivom nivou za ljudsku ishranu.

Ključne reči: babuška, deverika, akumulacija cinka, akumulacije Gruža i Bovan
Keywords: bream, Prussian carp, Zn concentrations, reservoirs Gruža i Bovan

INTRODUCTION

Water contamination with metals is a very important problem in the contemporary world, and their presence in the aquatic environment is a serious issue that threatens not only the aquatic ecosystems but also human health (Jianguo et al., 2007). Metals from natural and anthropogenic sources are continually being released into aquatic ecosystems, and they are a serious threat because of their toxicity, long persistence and capacity for bioaccumulation (Papagiannis et al., 2003). Mainly pollution sources leads to fish contamination with metals originated from industrial and domestic wastewaters (Tuzen, 2009). Zn is essential metal, since it play an important role in biological systems, but also can produce toxic effects when its intake is elevated excessively. Aquatic organisms are widely used to biologically monitor variation in environmental levels of anthropogenic pollutants (Farkas et al., 2003). Knowledge of metal concentrations in fish is important both with respect to nature management and human consumption of fish (Ebrahimpour and Mushrifah, 2010). Muscles are often a major tissue of interest for routine environmental monitoring, considering their implications for human consumption and potential health risk.

The aim of the present study was to assess the concentration status of Zn in two fish species (Prussian carp and bream) in two reservoirs (Gruža and Bovan) in order to determine whether there is a difference in the metal accumulation between species and between reservoirs. Moreover, the metal loading in fish muscle was determined to assess the risk to humans from the consumption of fish.

MATERIALS AND METHODS

The field work was conducted during the July of 2011 (Gruža Reservoir) and the May of 2012 (Bovan Reservoir). Two fish species: Prussian carp (*Carassius gibelio*) and bream (*Abramis brama*) were collected with nets of different lengths, widths and mesh diameters. The species were selected as those that are regular in fisherman catch in the study reservoirs. Specimens were sacrificed with a quick blow to the head, measured for their total weight (g) and standard and total body length (cm), and subsequently dissected. Mean values (±SD) for total length and weight of fishes in Gruža Reservoir were: 43 ± 16.57 cm and 1,120 ± 560.50 g for Prussian carp and 38 ± 9.09 cm and 608 ± 365.10 g for bream, respectively. Mean values (±SD) for total length and weight of fishes in Bovan Reservoir were: 35.33 ± 11.11cm and 883.66 ± 534.42 g for Prussian carp and 26.5 ± 2.17 cm and 585.33 ± 213.71 g for bream, respectively. Samples were removed from the right dorsal muscle, washed with distilled water and transferred to the laboratory.

In the laboratory, fish samples (~1.5 g) were digested in an Advanced Microwave Digestion System (ETHOS 1, Milestone, Italy) using a mixture of 65% nitric acid and 30% hydrogen peroxide (Merck, Darmstadt, Germany, 10:2 v/v) at 220ºC for 20 min. After cooling to room temperature and without filtration, the solution was diluted to a fixed volume (volumetric flask, 25 ml) with deionized water. Concentration of Zn was measured in fish muscle in triplicate using a Thermo Scientific iCAP 6500 Duo ICP

instrument (Thermo Fisher Scientific, Cambridge, United Kingdom). The potential presence of trace elements in chemicals used in sample preparation was resolved by using a number of blank samples. Multi-elemental plasma standard solution, Multi-Element Plasma Standard Solution 4, Specpure®, 1000 µg/ml certified by Alfa Aesar GmbH & Co KG, Germany, was used to prepare calibration solutions for ICP-OES. The detection limit for Zn was 0.109 mg kg^{-1} mg kg^{-1}.

All concentrations were expressed as mg kg^{-1} wet weight (ww).

RESULTS AND DISCUSSION

Zn, as an essential mineral for both animals and humans, showed a protective effect against the Cd and Pb toxicity (Malik et al., 2010). On the other hand, in high concentrations can be toxic for aquatic organisms as well as for the human population.

Average concentration (mg kg^{-1} ww) of Zn found in the muscle tissue of Prussian carp and bream in two Reservoirs is given as Figure 1. As can be seen, Zn concentrations were generally lower in bream (4.49 and 4.56 mg kg^{-1}) than in Prussian carp (14.49 and 12.83 mg kg^{-1}). The investigated species are of the same family (Cyprinidae). Prussian carp (e.g. *Carassius gibelio*) is zooplankton feeder (Ebrahimpour et al., 2011), while bream (e.g. *Abramis brama*) is benthophagus. Because of breams diet mainly consists of invertebrates -chironomid larvae and other benthic organisms, the metal levels detected in bream muscle tissue reflect the pollution level of the sediment and its biota, rather than the prevailing pollution state of the water (Rajkowska and Protasowicki, 2013). Considering that the main food of carp is free-floating zooplankton, metal concentrations in the muscle tissue of carp reflects the degree of water pollution. In such conditions, according to previous studies (Farkas et al., 2002), the metal uptake from food is predominant.

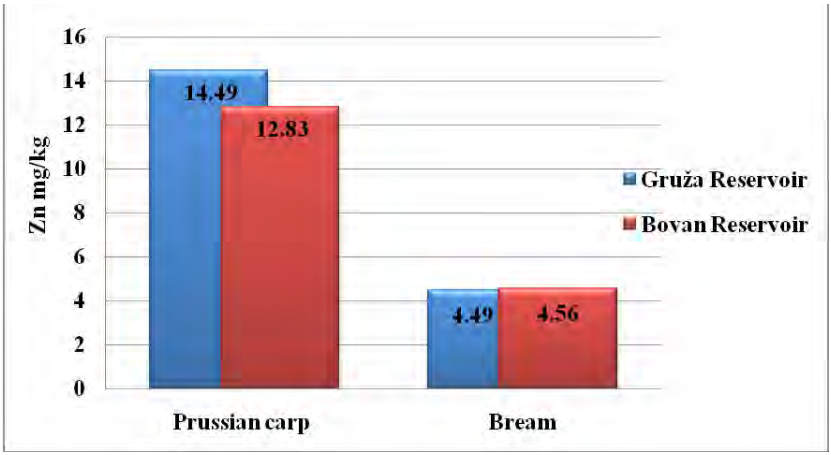

Figure 1. Comparative Zn concentrations in two fish species in two reservoirs

According to Ranković and Simić 2006, Gruža Reservoir is eutrophic reservoir as well as Bovan Reservoir (Ostojić, 2006). As seen in Figure 1, there were no differences in metal accumulation between two reservoirs which can be associated with same trophic level of reservoirs.

Concentrations of Zn were below national permitted concentrations (for canned fish meat, 100.0 mg kg^{-1} ww) in all analyzed muscle samples of two analyzed fish species, which indicates that the meat of studied species should be safe for utilization in human diet.

CONCLUSIONS

There was significant difference on Zn concentrations between species but no significant difference established between reservoirs. Also, meat of this two fish species from both reservoirs is safe for human consumption.

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