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TRACE METALS IN *GASTEROSTEUS ACULEATUS* L. AND ITS PARASITES FROM THE GULF OF GDAŃSK

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Abstract

In this study, the concentrations of trace metals in typical parasites of the three-spined stickleback, *i.e. Schistocephalus solidus* (Cestoda) and *Thersitina gasterostei* (Copepoda), and in the sticklebacks (infected or uninfected) were compared. Concentrations of Mn, Co, Ni, Cu, Zn, Cd and Pb were determined. The accumulations of metals suggested that *S. solidus, T. gasterostei* and their hosts could serve as biological indicators of heavy metal contamination.

INTRODUCTION

In recent years, it has been confirmed that some species of parasites are able to accumulate higher concentrations of trace metals than their hosts (Avenant-Oldewage 1995, Sures and Taraschewski 1995a, b, Sures *et al.* 1997a, b). Extremely high concentrations of trace metals were found in such fish parasites as adult acanthocephalans and slightly lower in adult cestodes (Sures and Taraschewski 1995b, Sures *et al.* 1997a, b). Parasites also contributed to the increase in sensitivity of infected fish to the toxicity of trace metals (Pascoe and Cram 1977, Pascoe and Mattey 1977).

A variety of organisms has been investigated as potential biological indicators of pollution in the aquatic environment (Sures *et al.* 1997a). *Gasterosteus aculeatus* frequently occurring in the Gulf of Gdańsk and capable of accumulation of trace metals was previously examined as a bioindicator species (Kowalewska and Korzeniewski 1991, Popławska and Korzeniewski 1991). There is a need for some new bioindicators because of the increase of environment pollution and rapidly growing urbanization in the coastal region of the Baltic Sea (Protasowicki 1991a, b, Seisuma and Legzdina 1991).

Typical parasites of *G. aculeatus*, very frequent cestodes (plerocercoids) *Schistocephalus solidus* and copepods *Thersitina gasterostei* have not been used as tags for trace metals so far and their usefulness in this regard has been investigated in the present study.

MATERIAL AND METHODS

The sticklebacks were caught in the coastal zone of the Baltic Sea (the Gulf of Gdańsk) between January 1994 and December 1995. The fishes and their parasites were collected and kept frozen until submitted to analyses for trace metals.

The following samples in triplicates were used for chemical analysis: plerocercoids *Schistocephalus solidus,* copepods *Thersitina gasterostei,* muscles and bones* of three spined stickleback infected by *S. solidus,* muscles and bones* of uninfected stickleback, gills of stickleback infected by *T. gasterostei.*

All samples were weighed and dried at 65°C to a constant weight and homogenized in a porcelain mortar. The homogenates were weighed again and digested in an Automatic Microwave Digestion System (MLS 1200) using concentrated HNO_3 Suprapur (Merck) and triple distilled water (obtained with the apparaturs Destamat Heareus Quarzglas). Mn, Co, Ni, Cu, Zn, Cd and Pb were determined by AAS method (Philips PU 9100 Atomic Absorption Spectrophotometer) using deuterium - background correction. To avoid errors caused by contaminations, all samples were analysed in triplicates.

RESULTS

As shown in Table 1, concentrations of trace metals differed among the examined samples. Metals in samples containing the muscles of both infected and uninfected sticklebacks, listed in order of decreasing concentration assumed the sequence: Zn > Mn > Cu > Pb > Ni > Co > Cd. The sequence in the gills and copepods *T. gasterostei* differed from the previous samples since the concentration of Pb seemed

*further referred to as muscles

to exceed concentration of Cu. Samples containing *S. solidus* seemed to contain more Pb and less Ni in relation to Cu than muscles of uninfected hosts (Tab. 1). The concentrations of Zn and Mn were invariably much higher than those of other heavy metals.

Trace metal concentrations in the ectoparasite (*T. gasterostei*) were generally higher than those in the endoparasite (*S. solidus*), with the exception of Ni. The most marked difference was observed in the case of Mn which occurred in the ectoparasite at the same concentration level as in muscles and gills of sticklebacks. However, interestingly in *S. solidus,* the concentration of Mn was 3.5 times lower than in the remaining samples studied. The lowest concentration of Zn (only 185 $mg \cdot g^{-1}$) was also observed in the same samples.

The metal concentrations in fish gills were lower compared to copepods, particularly in the case of Pb, Cu and Zn, but differences were not significant.

S. solidus concentrated less metals than fish (Mn and Zn) or at the same level (Co, Cd and Pb). Plerocercoids concentrated more metal than fish only in the case of Ni. Fishes infected by cestodes accumulated more Cu, Mn and Zn than uninfected fishes.

DISCUSSION

Differences in accumulation of trace metals by parasites and their hosts were insignificant and the usefulness of both types of organisms as bioindicators of trace metals seems comparable.

Higher concentrations of trace metals in parasites than in hosts were found in adult parasites (Sures and Taraschewski 1995b, Sures *et al.* 1997a, b). Larval stages of parasites have not been studied. The results presented here suggest that parasites can accumulate metals in adult stage (as a result of a long period of feeding?).

Pascoe and Cram (1977) observed that sticklebacks infected by plerocercoids *S. solidus* were more sensitive to the toxicity of cadmium. The investigations of Pascoe and Mattey (1977) showed that the plerocercoids *S. solidus* contained less Cd than their hosts. In our study, practically the same level of Cd concentration in plerocercoids and infected fish (0.53 i 0.50 $mg \cdot g^{-1}$) was found. Uninfected sticklebacks contained slightly higher Cd concentrations (0.63 $mg \cdot g^{-1}$). The same was found in the case of Pb, Ni and Co: infected sticklebacks contained less metals than uninfected fishes. The presence of plerocercoids seems bring about the to decrease, at least to a certain degree, of the concentration of metals in tissues of hosts.

Table 1

Concentration of trace metals (μg per g of dry weight) in various samples

Samples	No[a)]	Mn[b)]	Co	Ni	Cu	Zn	Cd	Pb
muscles of uninfected stickleback	3	49,65 ± 1,62	0,92 ± 0,38	1,82 ± 0,96	3,26 ± 0,08	320,9 ± 13,2	0,63 ± 0,09	2,67 ± 0,13
muscles of fish infected by *S. solidus*	3	54,85 ± 2,05	0,71 ± 0,11	0,97 ± 0,52	4,01 ± 0,15	325,6 ± 21,2	0,50 ± 0,05	2,08 ± 0,13
Schistocephalus solidus	3	14,27 ± 0,29	0,87 ± 0,06	2,91 ± 0,48	5,19 ± 0,29	185,0 ± 60,6	0,53 ±0,03	2,61 ± 0,34
Thersitina gasterostei	3	50,38 ± 1,59	1,11 ± 0,63	2,63 ± 1,07	5,72 ±0,85	450,8 ± 25,1	0,76 ± 0,17	6,05 ± 0,49
gills of fish infected by *T. gasterostei*	3	52,68 ±0,51	1,11 ± 0,46	1,33 ± 0,72	2,93 ± 0,10	280,5 ± 4,35	0,52 ± 0,20	3,01 ± 0,48

[a)] No, number of samples

[b)] All results are given as mean ± standard deviation

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