HEAVY METAL BIOACCUMULATION IN THE SPIDER XEROLYCOSA NEMORALIS (LYCOSIDAE) FROM VARIOUSLY POLLUTED AREAS

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Introduction

Spiders constitute an important link in food chains. As predators they play an important role in the regulation of insect populations. They belong to the group of heavy metal macroconcentrators. Metals in spiders are deposed mainly in the midgut gland cells, in opisthosoma (Wilczek and Babczyńska, 2000; Wilczek et al., 2008). The contents of metals in the body of actively hunting spiders reflect environmental pollution level better than the concentration measured in web-building spiders. This feature is connected with the characteristics of their victims and direct contact with the ground surface. Spiders belonging to Lycosidae family, due to their high hunting activity, may be used as bioindicators of environmental pollution with heavy metals (Wilczek and Migula, 1996; Jung and Lee, 2012). The aim of this study was to check whether, and to how extent, an additional cadmium and copper supplementation of the insect prey of the spider *Xerolycosa nemoralis* changes the contents of the metals in the spider body in relation to developmental stage, sex and pollution level of the study sites.

Methods

In the study, adult and juvenile *X. nemoralis* (Westering, 1861) (Lycosidae) specimens were used. This species represents epigeic fauna. It is abundant in forest and meadow ecosystems. It do not build webs, but hunts actively. It hunts for small insects of thin chitin layer, such as aphids, collembolans, flies or other spiders (Nentwig, 1987). Spiders were collected from two variously polluted areas in Southern Poland: postindustrial waste heap in Wełnowiec – the district of Katowice. (50°17’ N, 19°00’E) and Pilica (50°28' N, 19°39' E), a reference site. Juveniles were caught in April, adult – in May. Collected individuals were kept in the laboratory for 21 days (RH: 60±10%: L14/D10; temp: L25/D15) and fed ad libitum with *Drosophila melanogaster* reared in the medium containing 0,25 mM $CdCl_2$ or 0,23 mM $CuSO_4$.Control group was fed with uncontaminated flies. Egg cocoons were collected directly in the field. To determine the concentration of Cd and Cu using a Solaar Unicam 939 atomic absorption spectrophotometer in a PU-93 090X graphite furnace. The results were analyzed using STATISTICA® v. 12.1 software, Tukey’s test, ANOVA, $p < 0.05$.

Results

Table 1. Bioaccumulation factor, BAF for Cd and Cu in spiders *X. nemoralis* fed with fruit flies reared on the media containing Cd and Cu, respectively.

Stadium/sex	BAF_{Cd} Pilica	BAF_{Cd} Wełnowiec	BAF_{Cu} Pilica	BAF_{Cu} Wełnowiec
juveniles	0,83	1,17	0,84	1,13
males	1,11	1,21	1,50	2,17
females	0,78	1,34	1,87	1,75

Irrespectively of the site, BAF for both metals in juveniles was lower than 1. In case of males, both Cd and Cu accumulation was higher than in females.

Table 2. Concentration Cd and Cu [$\mu g \cdot g^{-1}$ dry weight] (mean ± SD) in embryos and cocoons spiders *X. nemoralis* catch in: Pilica and Wełnowiec; control group. **a, b** different letters indicate statistically significant differences between sites (ANOVA, Tukey's test, *p<0.05)*

Sites	Structure	Cd [$\mu g \cdot g^{-1}$ dry weight]	Cu [$\mu g \cdot g^{-1}$ dry weight]
Pilica	embryos	0,634±0,37[a]	12,283±4,10[a]
	cocoons	0,982±0,42[a]	20,807±7,84[a]
Wełnowiec	embryos	0,055 ±0,013[b]	48,318±12,69[b]
	cocoons	0,155±0,082[b]	125,571±25,1[b]

Irrespectively of the site, the concentration of the metals was higher in cocoons than in the embryos. Cd concentration in the cocoons from the reference site was 6 times higher than in the cocoons of the females from the metal polluted site. In the embryos, the lowest Cd concentration was found in individuals from Wełnowiec. They had 12 times lower Cd concentration than the embryos from Pilica. In case of Cu, the metal concentration in the cocoons from Wełnowiec was 6 times higher than in the cocoons from Pilica. In the embryos from the polluted site, Cu concentration was 4 times higher than in the embryos from Pilica.

Conclusion

The higher BAF for Cu in all studied groups indicates that this metal is better assimilated than Cd. Cocoons can be an efficient barrier for the metals. It is possible that pre-exposure of spiders to metal pollution may enhance lower accumulation of the xenobiotics entering the organism with food.

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