

The effect of heavy metals on the expression of hsp 70 in soil invertebrates

Die Auswirkung von Schwermetallen auf die hsp 70 - Expression in Bodeninvertebraten

H. ECKWERT¹, M. ZANGER¹, S. REISS¹, H. MUSOLFF¹, G. ALBERTI¹,
H.-R. KÖHLER^{1,2}

¹ Zoological Institut I, University of Heidelberg, Im Neuenheimer Feld 230,
D-69120 Heidelberg, FRG

² Institut of Zoology, University of Hohenheim, Garbenstraße 30, D-70593 Stuttgart,
FRG

Stress proteins from the hsp 70 (stress-70) family usually are induced by different environmental factors and stress situations in order to protect proteotoxicity (protein denaturation). In the present paper, hsp 70 expression in response to heavy metal contamination was qualified and semi-quantified by biochemical and immunological techniques.

Originally uncontaminated adults of *Oniscus asellus* (Oniscidae, Isopoda) and *Julus scandinavicus* (Julidae, Diplopoda) were exposed to either 10, 50, or 100 mg/kg Cd²⁺ (as CdCl₂), to 100, 500, or 1000 mg/kg Pb²⁺ (as PbCl₂), or to 500, 1000, or 5000 mg/kg Zn²⁺ (as ZnCl₂) at 15 °C (*O. asellus*) or 10 °C (*J. scandinavicus*) for 3 weeks. In addition, mature specimens of *Alopecosa cuneata* (Lycosidae, Araneae) from heavy metal contaminated urban sites were investigated. After fixation in liquid nitrogen, constant amounts of protein in the homogenates were separated by SDS-PAGE and the stress proteins of the hsp 70 family stained specifically by immunoblot.

In *O. asellus* and in *J. scandinavicus* it was possible to induce hsp 70 by application of all tested heavy metal concentrations (except lead for *J. scandinavicus*). A double band at approximately 70 kD appeared in the immunoblot of stressed *O. asellus*: the larger protein has to be assigned as the inducible form (hsp 70), whereas the smaller protein, which also appeared in the controls, represents a constitutively expressed cognate gene product (hsc). In cadmium or zinc contaminated specimens of *J. scandinavicus*, only a single protein band occurred in the immunoblots. The highest applied concentrations of lead had not been found to induce hsp 70 in *J. scandinavicus*. Most probably, hsp 70 concentration in both the lead contaminated animals as well as in the controls were too small to be detected by the methods applied.

Semi-quantification of the immunoblots by image analysis revealed increasing amounts of hsp 70 induced by increasing concentrations of heavy metals in *O. asellus* as well as in *J. scandinavicus*. Resembling the situation in *O. asellus*, in the spider *A. cuneata*, a double band at approximately 70 kD could also be detected. Its intensity, however, was found to be independent from the contamination status of the site from which the animals were collected. In these species, a correlation of hsp 70 expression and the heavy metal content of the site's soil could not be found. Probably this effect may be due to the fact that predators are mainly influenced by the heavy metal content of their prey which does not necessarily represent the soil's contamination.