Uptake and effects of metals in soil invertebrates in relation to substrate properties, routes of exposure, internal concentrations and physiology

Soil invertebrates may be exposed to metals both through soil, soil pore water and food. Food exposure seems less important than exposure through soil, suggesting that pore water is the most important route of exposure. Speciation of metals in the pore water will affect their uptake by organisms, with the free metal ion being the most relevant, but other elements may interfere with the uptake process. This principle has recently been described in the Biotic Ligand Model (BLM) developed for acute metal toxicity for aquatic organisms (mainly fish). Recently, indications have been obtained that the principles underlying the BLM may also be applicable to soil organisms. But still many uncertainties exist, which need to be resolved before a BLM can be developed for metal toxicity in soil organisms.

In soil, physical-chemical properties of the soil and pore water and the physiology of test organisms may affect uptake, distribution and the consequent effects of metals. Expression of effects on the basis of internal concentrations may eliminate effects of different routes of uptake. This may however, not be the case for essential metals, such as copper, iron and zinc, which may be regulated by organisms. Determining the development of toxicity with time and assessing the uptake/elimination kinetics of the tested metals in the test organisms may provide further insight into routes of uptake and role of different factors (including soil properties) in determining uptake and effects. In this framework, it also is of importance to unravel not only the chemical but also the biological components of metal bioavailability.

This project aims among others at the following aspects:

- What is the main route of exposure of soil invertebrates?
- Which part of the total metal content of a soil or other substrate is available for uptake?
- Can uptake be linked to metal speciation and are principles of a BLM applicable to soil invertebrates?
- Which factors determine the uptake of metals in soil invertebrates?
- Which factors determine the toxicity of metals being taken up?
- What mechanisms do soil invertebrates have to cope with metal exposure?

Research is carried out with Collembola (*Folsomia candida*) and enchytraeids (*Enchytraeus crypticus*), but may also include other organisms like earthworms (*Eisenia andrei*), oribatid mites (*Platynothrus peltifer; Oppia nitens*) and isopods (*Porcellio scaber; Oniscus asellus*)

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