UEBL Projects

Project: Determination of uptake and elimination rates for isotopically enriched ZnO nanoparticles by *Eisenia fetida* and the potential for trophic transfer

Summary: The use of engineered metal nanoparticles (NP) in consumer products such as washing machines and cosmetic products is becoming widespread. As an example, ZnO NPs have the ability to absorb ultraviolet (UV) light when below the size of 100 nm, and are commonly found in sunscreens. Considered to be the richest family of nanostructures, ZnO NPs are also used as rubber additives, pigments, and in photoelectrodes. Nanoparticles can occur naturally in the environment, may be made intracellularly or extracellularly by organisms, and have even been found within a 10,000 year-old ice core sample from Greenland. Environmental exposure to nanoparticles is not a new concept and organisms have adapted to natural exposures; the concern lies with the recent influx of manufactured nanoparticles that may have a detrimental effect on the environment. With the majority of NPs being released to the environment through municipal waste water and sewage sludge mediums, aquatic and terrestrial systems are a likely sink for manufactured nanoparticles. The fates of these nanoparticles once released into the environment and the potential for transfer of NPs to organisms higher in the food web (e.g. birds and small mammals) are open questions. This investigation will utilize nanoparticles with a chemical fingerprint to track the fate of NPs in soil and the potential for uptake and transfer to higher-level organisms using the earthworm *Eisenia fetida*. Earthworms are in constant direct contact with soils and are an important potential entry point into the terrestrial food web where bioaccumulation of NPs can occur in higher-level organisms. The fingerprinted NPs in this study will be readily discernibly from other sources of Zn in the soil and the earthworm. The behavior of the fingerprinted NPs in a soil system will be compared with other non-nano forms of Zn (bulk ZnO powder and $ZnCl_2$) over time to evaluate the impact of soil ageing on the bioavailability of the different Zn forms. This general approach will be used to test the following hypotheses; 1) There will be no difference in the uptake or elimination of Zn by *E. fetida* among all three forms of Zn, indicating that zinc NPs are easily eliminated by *E. fetida* and there is no potential for transfer via earthworms to the terrestrial food web and, 2) There will be no difference in the uptake or elimination of Zn by *E. fetida* among the three zinc treatments after 42 days of ageing and that these treatments will not differ from the initial experiment.