Biological application of PIXE: evaluation of the genotoxic potential of the mineral coal tailings through the *Helix aspersa* (Müller, 1774)

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The determination of chemical elements in the environment and knowledge of the interaction of such elements with living organisms is an important tool for controlling toxicity, environmental pollution and occupational exposure.

Coal mining is an activity with a high potential for environmental pollution. Coal has been described as the most significant pollutant of all the fossil fuels, containing a heterogeneous mixture. Many elements present in coal byproducts as well as coal tailings are rich in potentially toxic and genotoxic metals, which ultimately lead to profound changes in cells, tissues, populations, and ecosystems.

The purpose of this study was to assess the genotoxic potential of the mineral coal tailings using the land snail Helix aspersa. Animals were divided in three groups, clustered in plexiglass cages: control (animals fed with organic lettuce), coal tailings (animals living in a layer of pyrite tailings and fed with organic lettuce), and mine lettuce (animals fed with lettuce grown in an area located in a deposit of coal tailings). The hemolymph was collected at different exposure times (24 h, 48 h, 72 h, 96 h, 1 week, 2 weeks, 3 weeks, and 1 month) for comet assay analyses. The DNA damage was assessed by the comet assay, while the metal content in the tissue was evaluated through the PIXE technique. To that end, snail tissues were dried, pulverized and pressed into pellets. PIXE experiments were carried out using 2.0 MeV proton beams with typical currents of the order of 2 nA. The X-rays induced in t he samples were detected by a Si(Li) and a HPGe detectors placet at $\pm$ 45º with respect to the beam.

Results showed that the animals of the coal tailings and mine lettuce groups presented higher levels of elements like Na, Mg, Al and Si and DNA damage in relation to the control group at all exposure times. These results demonstrate that the coal pyrite tailings are potentially genotoxic and that H. aspersa has proven to be a sensitive instrument for a better risk assessment of environmental pollution.

[1] D.D Leffa, A.P. Damiani, J. da Silva, J.J. Zoche, C. E. I. dos Santos, L. A. Boufleur, J. F. Dias, V. M. de Andrade, Arch. Environ. Contam. Toxicol., 59 (2010) 614-621.