Title:

Formation and aggregation of nobel metals nanoparticles in extracts of peats. Biosynthesis, isolation, determination and cytotoxicity study.

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Abstract:

Formation of an aggregation of metal nanoparticles in the alluvial sediments of peat (turf) is a natural process, beneficial for the environment, due to limitation of cytotoxic metals presence and absorption by living organisms. In this work, such process was adopted to the in vitro conditions, and obtained nanoparticles were examined focusing on their cytotoxicity against selected model organisms and cell lines.

Peat is a porous matter of plant and animal origin. During the decomposition of organic molecules, humic acids are formed. Thanks to active centres, these acids can affect pollutants, which may be chemical compounds (e.g. salts), containing heavy metal cations and reduce heavy metal ions to form metallic nanoparticles.

The metal nanoparticles synthesized in vitro on aqueous peat extracts (copper, silver and zirconium) are an attempt to reproduce the processes taking place in the natural environment, while quantum-mechanistic simulations are an attempt to depict the mechanism of creating metallic precipitations in conditions similar to natural ones.

Due to their size, the obtained nanomaterials may have a toxic effect on higher organisms. Small dimensions may enable them to overcome the cellular barrier and cause disturbances of processes occurring inside the cell, of basic importance.

The conducted toxicity tests, such as the antioxidant response of *Lepidium sativum* L., *Lotus uliginosus* Schkuhr., survival tests of *Arthemia salina*, HeLa, A549, confirm the negative effect of metal nanoparticles on selected model groups of organisms.

Depending on the metal cation used for syntheses, inhomogeneous sizes of nanoparticles are obtained, which in turn affect the tested model organisms in a different way, completely damaging them, inhibiting their development (tests carried out on plants and nanoparticles). Deprivation of adaptive capacity (tests of organism and cell survival) or forced cellular stress of the analysed organism results in apoptosis before the cells can produce appropriate antibodies and counteract the factor that causes this stress.

The research involved the synthesis of copper, silver, and zirconium nanoparticles in the environment of extracts prepared from commercially available peat mixtures. As part of the research subject, the optimization of the synthesis of nanoparticles was performed in terms of obtaining products with reproducible physicochemical properties (structure, morphology, particle size, dispersion stability).

Toxicity tests were carried out on model organisms: cockscomb (*Lepidium sativum* L.), mud chamois (*Lotus uliginosus* Schkuhr), along with the survival tests of brine shrimp (*Arthemia salina*), and cytotoxicity studies of obtained nanomaterials on the human cervical cancer cell line (HeLa) and non-small cell lung cancer cell line (A549). Performing research on the interaction of nanoparticles on selected models of organisms and cell lines made it possible to determine the toxic effects, safety and threats resulting from the conscious or unintentional presence of nanoparticles in the natural environment..