

Nanocomposites and nanomaterials

Approaches And Methods For Evaluating Toxicity of Lead Nanoparticles

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Certain physical and chemical properties of nanoparticles allow using them in different biomedical applications but this is often challenged by concerns about the safety of these materials. Traditional approaches for evaluating their toxicity are not applicable because the most important is the surface of such particles and not the mass concentration [1]. Nanoparticles can penetrate in intact form via respiratory tract, gastrointestinal tract and skin, overcome the blood-brain and placental barriers, accumulate in the bone marrow, lungs, liver, kidneys, lymph nodes; have a long half-life [2].

The aim of this experiment, which was performed in two stages, was to evaluate *in vitro* and *in vivo* toxicity of lead compounds by comparing its ion form ($\text{Pb}(\text{NO}_3)_2$) with nanoform (PbS, particle size 30 and 65 nm).

In vitro assessment of viability and metabolic changes was performed on human cell cultures A-549, Colo-205, HaCat and Hep-G2 (hepatocellular carcinoma) as well as blood plasma proteins (albumin, immunoglobulin G, proteins of blood clotting) in a test with trypan blue, methyltetrazole, neutral red. It was established that PbS of both sizes had a greater cytotoxic effect on the A-549 and Colo-205 cells. This may indicate that the main target is lung epithelium and intestine.

In vivo study was performed in subchronic experiment on Wistar rats and showed that PbS nanoparticles were more toxic than lead ions causing a considerable disturbance of heme synthesis, changes in peripheral blood cells. PbS also had a toxic effect on liver, kidney and pancreas with lipid and protein metabolism, oxidative stress activation and inhibition of enzyme activity of antioxidants.

These results suggest that PbS nanoparticles have a more pronounced toxic and damaging effect on the cells and the organism as compared to its ionic form.

1. Christian P., Kammer V., Balousha P., Hofman Th. Nanoparticles: structure, properties, preparation and behavior in environmental media // *Ecotoxicology*. -2008. -17. -P. 326-343.
2. *Nanotoxicology - Interactions of Nanomaterials with Biological Systems / Edited by Yuliang Zhao and Hari Singh Nalwa*, 2006. -500 p.