Experimental study of γ-radiation effects on human cells

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The population in the north is subject to the influence of a complex of natural and man-caused environmental factors that may be characterized as extreme for man. Natural radiation background and anthropogenic radioactivity source represent a high population risk factor to health of inhabitants residing at high latitudes. The negative effects are aggravated by high industrial contamination level. The most dangerous is the mining and smelting complex, which is the main source of the environment pollution with heavy metals. Heavy metals like radiation are well-known mutagens and carcinogens. The combined influence of heavy metals and radiation on human organism seems to be insufficiently investigated.

The studies of the cause-and-effect relationship between a specific factor influence and negative health effects represent rather a hard task for experts. A particular solution of this problem can be considered experimental studies that give us the important information about mechanisms and effects, of both single factor and joint, combined and integrated environment influence at different levels of organizing. The study of effects at the genetic level allows us to estimate the ultimate consequences risk from negative influence on population health at earlier pre-clinical stages and to develop a system of preventive measures, aimed at the control of processes of free-radical damage of cells and DNA.

Our experiments *in vitro* are based on the comparison of genotoxic effects of nickel salt, as a specimen of heavy metals with transitional valence, possessing mutagen and carcinogen properties, and γ-radiation. It is well-known that the genotoxic effects of nickel as well as γ-radiation are caused by free-radical oxidative processes. The investigation included thee experimental sections: I - the adaptive response (AR) formation; II - the role of superoxidedismutase (SOD) in remaining cell homeostasis; and III - the antioxidant role of Vit A in modifying the nickel and γ-radiation genotoxic effects. The applied evaluation criteria have been cell viability estimation, replicative and repair DNA synthesis determination and DNA breaks formation estimation by the method of alkaline elution of DNA.

For the first time, we have shown the AR response formation in human cells pre-iradiated with adaptive dose of γ-radiation to the challenge doses of $NiSO_4$ and AR induced by adaptive dose of $NiSO_4$ to the challenge doses of γ-radiation. It was found that SOD activity inhibition increased the genotoxic effects of $NiSO_4$ and γ-radiation revealing as a decrease of cell viability and replicative and repair DNA synthesis. The pretreatment with Vit A of human cells treated with γ-radiation resulted in increase of cell viability and decrease of DNA repair synthesis, however, the DNA replicative synthesis did not change.