Do metal nanoparticles affect the biosynthesis of bioactive plant metabolites? - studies on an *in vitro* culture model of species from the Brassicaceae family with pro-health benefits

Plant cultivation technologies and consequently food obtaining, could have enormous implications for our physical and mental health.

The diseases that develop due to faulty diet and vitamin and mineral deficiencies, include many pathological conditions, including: cardiovascular and digestive system diseases, metabolic disorders, hyperlipidemia, osteoporosis, rickets, scurvy and a whole range of other problems, such as reduction of systemic immunity, or delayed growth and physiological maturation in adolescents.

Scientists are still looking for effective solutions to these problems; also at the level of prophylaxis, basing their actions especially on natural plant resources. Research on the therapeutic properties of plants is largely focused on the determination of metabolites that may be related to their therapeutic uses.

Given their worldwide availability and their economic importance in the "super food" category, plants from the Brassicaceae family seem to be an excellent research material to improve their health-promoting biological activity. These plants can be an ideal natural source of high-quality nutritional products known as "functional foods".

As part of the project, research will be conducted on such important species of crop plants as: *Brassica oleracea* L. var. *italica* (broccoli), *Brassica oleracea* L. var. *acephala* (kale), *Brassica rapa* L. var. *japonica* (mizuna), *Brassica rapa* L. var. *chinensis* (pak choi), *Nasturtium officinale* R. Br. (watercress) and *Eruca sativa* Mill. (*Eruca vesicaria* L. Cav) (rocket).

The planned project involves interdisciplinary research combining biotechnology, nanotechnology, phytochemistry and pharmacology in order to develop technologies for the integrated management of nutrients, as well as increasing their value in terms of pro-health action. Based on the new idea of phytofortification with non-ionic nanoparticles of silver, gold, platinum and copper, will be show their effect on production of metabolites in the *in vitro* microshoot culture model, which is one of the most important innovative applications of plant biotechnology research from a therapeutic point of view.

For the project will be applied specific small metal nanoparticles with dimensions about 5 nm. The uptake of nanoparticles by plants is species-specific and depends on the surface charge and composition and size of nanoparticles. Literature data show that small-sized nanoparticles show higher biological activity and can be used in biomedical products, where it is particularly important to minimize the number of nanoparticles while maintaining the same high efficiency.

In vitro culture biomass extracts will be phytochemically (qualitatively and quantitatively) tested for a wide profile of secondary metabolites, especially glucosinolates, flavonoids, phenolic acids and elements, as well as for biological activities (in vitro and in vivo models): anticancer, antibacterial, antifungal, antioxidant, anti-inflammatory as well as for the cytotoxic and genotoxic activities.

A very important added value of the project is the unique use of the *in vitro* culture model (elimination of environmental factors), which significantly increases the scientific value compared to *in vivo* experiments.

For the sake of health and environmental safety, the experiment undertaken assumes accurate and an in-depth analysis of not only phytochemical changes occurring in the tested plants, but also the determination of the entire cytotoxicity profile and safety studies, as well as the evaluation of the pro-health potential of biofortified extracts.

To sum up, the proposed project will be the first report deals on plant supplementation with non-ionic metal nanoparticles in the context of biotechnological solutions (nano-biotechnology). Moreover, it will be the first study showing statistically significant correlations between the content of nanoparticles, and the content of biologically active compounds in Brasicaceae plants, taking into account their pro-health potential.