Single particle ICP-MS characterization of engineered nanoparticles uptake and bioaccumulation by edible plants

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Due to their unique physical and chemical properties, the use of engineered nanoparticles (ENPs) has exponentially increased in recent years causing their presence in the environment. As a consequence, ENPs can interact with plants and their impact on edible plants in the context of food safety needs to be investigated. Despite the rapid development of NPs applications, the mechanisms of plant penetration by ENPs are not well understood.

The main aim of the project was the development of analytical methodology for characterization of engineered nanoparticles in edible plants to get the knowledge about their uptake and bioaccumulation process. Enzymatic digestion method with Macerozyme R-10 was developed in order to release the largest amount of intact NPs from different parts (roots, stems and leaves) of studied plants. In the next step of the proposed project, SP-ICP-MS was used to determine the dissolved and nanoparticulated forms and define the differences in the uptake, distribution and degree of accumulation of NPs in edible plants. The influence of ICP MS acquisition parameters on the results obtained has been evaluated.

Obtained results show that depending on the chemical nature of NPs, they are distributed in various plant organs in different degrees as intact nanoparticles (as a result of metal NPs uptake and transport up to above ground organs) or can undergo transformation to dissolved forms of the metal. This information is essential from the point of view of food safety taking into account that different parts of the studied plants are edible. The developed methodology combining enzymatic sample digestion and SP-ICP-MS proved to be reliable and highly sensitive and can be used at an environmentally relevant trace concentration levels.

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