The use of mass spectrometry (SC-ICP-MS) to investigate NPs in biological systems

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ABSTRACT

There is no denying that nanoparticles (NPs) and nanotechnology nowadays become one of the most important issues in both terms of advantages and limitations. NPs are widely applied in a range of fields. Unfortunately, this can lead to a viable threat since NPs can ubiquitously disperse into an ecosystem. The release of a high amount of engineered nanomaterials (ENMs) into soil and water can be unbeneficial for the growth of terrestrial plants, especially for agricultural crops. Recently, the effect of NPs on plants has been intensively studied. NPs interaction with plants depends on various factors such as: their concentration, type, size, shape, specific surface area, and stability.

Moreover NPs can change their behaviors via dissolving and agglomerating. Their transportation from manufacture to our hands, their exposure to light, and temperature or to culture medium cannot guarantee that their original characteristics such as chemical composition and particles size will be constant overtime. Therefore, the characterization and detection of NPs before and after being applied to plants is equally important.

However, in agriculture, nanoscience has initiated nanopriming of seed using nanoparticles to improve germination of seeds. Recently, functional nanoparticles are gradually gaining a global attraction of agricultural scientist due to their infusion in seed invigoration, plant growth and pest control.

The study of NPs uptake in plants is a relatively new field of investigation. Since there has been no standard protocols for quantification and characterization of NPs of various origin and composition, in plant tissues, conflicting data was remarked. Currently cellular metal content is analyzed in a volume of cells that are acid-digested and the metal or particle content is given per number of cells rather than on a per-cell basis. This model of analysis assumes also that cells accumulate the same (average) amount of metal. These limitations (i.e. inability to quantify NPs on a per-cell basis) can be overcome through the use of single cell ICP-MS (SC-ICP-MS) that allows larger number of cells to be examined in a more accurate and quantitative manner.

During the speech it will be discussed how various feature of mass spectrometry techniques can supplement each other towards raising complementary information which extends the capability to characterize nanoparticles (NPs), especially in a view of their interaction within biological systems.

KEY WORDS: nanoparticles, mass spectrometry techniques, SC-ICP-MS.