Imaging of chemical composition in plant tissues - revealing physiological mechanisms to improve food quality and safety

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Trace elements are essential components of living systems, but at the same time they can be toxic at concentrations beyond those necessary for their biological functions. In addition, the toxicity can be extended to other non-essential elements of very similar atomic characteristics that can mimic the properties of trace elements.

Trace element malnutrition affects more than half of the world's population, while on the other hand industrialization, traffic and extensive use of fertilizers have resulted in exceedingly high concentrations of non-essential elements in food crops, posing risks to human health.

In order to be able to develop and improve phyto-technologies that enable production of safe and quality food, knowledge on the basic physiological mechanisms involved in trace and non-essential element uptake, transport, accumulation and ligand environment in plants is needed. Such studies are nowadays supported by highly sophisticated X-ray based techniques such as proton induced X-ray emission (micro-PIXE), synchrotron based X-ray fluorescence spectroscopy (SR-micro-XRF) and X-ray absorption spectroscopy (XAS) that enable imaging of trace element distribution and their ligand environment in plant tissues and cells with high spatial resolution and sensitivity.

Selected case studies of trace and non-essential element distribution and speciation in crop and model plant species, achieved by interdisciplinary work, will be presented.