X-ray spectrometry in plant biology

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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 a trace element.

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 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 synchrotron based X-ray fluorescence spectrometry, proton induced X-ray emission and X-ray absorption spectroscopy, enabling imaging of element distribution and determination of speciation and ligand environment of trace elements in biological tissues and cells with high spatial resolution and sensitivity.

Selected case studies of metal distribution and speciation in selected model and crop plants, achieved by interdisciplinary work, will be presented.

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