USING MICRO-PIXE TO EVALUATE NUTRITIONAL VALUE OF EDIBLE PARTS OF PLANTS

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Optimal development of all organisms depends upon proper provision of sufficient amounts of essential mineral elements, and the exclusion of those that are potentially harmful. The continuous cycling of elements in the food chain begins in the soil solution, where plants acquire elements with roots and transport them across their tissues, ending up, directly or indirectly, on our plates. Variation in the element compositions of edible plant-based produce is therefore of considerable importance for human nutrition. Particularly, seven elements (iron, zinc, magnesium, copper, calcium, selenium and iodine) are often lacking in human diets with the resulting negative impacts on health and wellbeing of more than two billion people worldwide. Substantial progress has been made in increasing concentrations of these elements in edible plant tissues to reduce malnutrition in a process called biofortification. This increase in density of elements in a crop can be achieved through plant breeding, transgenic techniques, or agronomic practices, and when biofortified produce is consumed regularly, measurable improvements in human health and nutrition are seen. Besides increasing density of essential elements, we also need to limit accumulation of those potentially harmful (e.g., cadmium, lead, arsenic, mercury) to edible plant tissues. However, concerted action is required to expand our understanding of uptake, transport and final deposition of essential elements and potentially harmful elements in edible plant tissues. Since majority of these elements can be detected using PIXE, we will present case studies (examples in Figure 1) where it was used to determine composition of edible parts of plants.

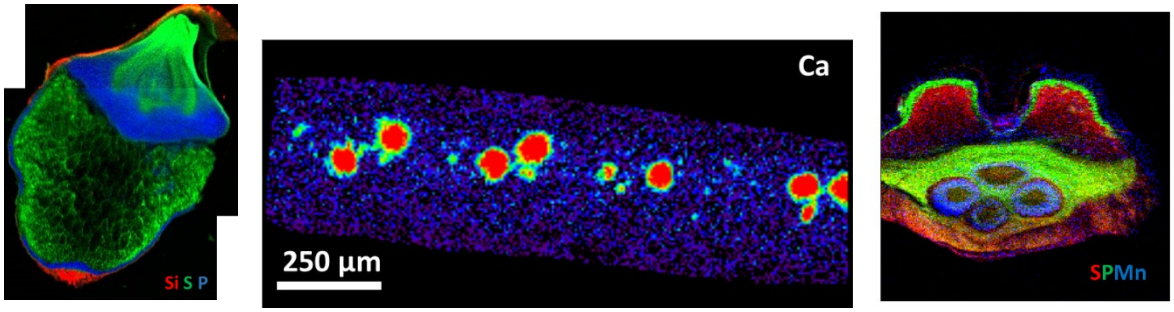

FIG. 1. Micro-PIXE analysis of rice grain (left), spinach leaf (middle) and barley grain (right). Si, silicon; S, sulphur; P, phosphorus; Ca, calcium; Mn, manganese.

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