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Closed vessel miniaturized microwave assisted chelating extraction for determination of trace metals in plant materials

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In recent years, the use of closed vessel microwave assisted extraction (MAE) for plant samples has shown increasing research interest which will probably substitute conventional procedures in the future due to their general disadvantages including consumption of time and solvents.
The objective of this study was to demonstrate an innovative miniaturized closed vessel microwave assisted extraction (μMAE) method under the use of EDTA (μMAE-EDTA) to determine metal contents (Cd, Co, Cu, Mn, Ni, Pb, Zn) in plant samples (Lolio-Cynosuretum) by inductively coupled plasma-optical emission spectrometry (ICP-OES). Validation of the method was done by comparison of the results with another miniaturized closed vessel microwave HNO_3 method (μMAE-H) and with two other macro scale MAE procedures (MAE-H and MAE-EDTA) which were applied by using a mixture of nitric acid (HNO_3) and hydrogen peroxide (H_2O_2) (MAE-H) and EDTA (MAE-EDTA), respectively. The already established MAE-H method is taken into consideration as a reference validation MAE method for plant material. A conventional plant extraction (CE) method, based on dry ashing and dissolving of the plant material in HNO_3, was used as a confidence comparative method. Certified plant reference materials (CRMs) were used for comparison of recovery rates from different extraction protocols. This allowed the validation of the applicability of the μMAE-EDTA procedure.
For 36 real plant samples with triplicates each, μMAE-EDTA showed the same extraction yields as the MAE-H in the determination of Cd, Co, Cu, Mn, Ni, Pb, and Zn contents in plant samples. Analytical parameters in μMAE-EDTA should be further investigated and adapted for other metals of interest.
By the reduction and elimination of the use of hazardous chemicals in environmental analysis and thus allowing a better understanding of metal distribution and accumulation process in plants and also the metal transfer from soil to plants and into the food chain, μMAE-EDTA is seen as a promising technique for achieving green chemistry goals.