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Closed vessel microwave assisted extraction - An innovative method for determination of trace metals in plant materials

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Determination of metal concentrations in plant samples is important for better understanding of effects of toxic metals that are biologically magnified through the food chain and compose a great danger to all living beings. In recent years the use of microwave assisted extraction for plant samples has shown tremendous research interest which will probably substitute conventional procedures in the future. Generally conventional procedures have disadvantages including consuming of time and solvents.

The objective of this study is to investigate and compare a new closed vessel microwave extraction (MAE) method with the combination of EDTA (MAE-EDTA) for the determination of metal contents (Cd, Mn, Pb, Zn) in plant samples (*Lolio-Cynosuretum*) by ICP-OES. Validation of the method was done by comparison of the results with another MAE procedure (MAE-H) which is applied with the mixture of 69% nitric acid (HNO_3) and 30% hydrogen peroxide (H_2O_2). Moreover, conventional plant extraction (CE) method, for which the dissolution of plant samples were handled in HNO_3 after dry ashing at 420°C, was used as a reference method. Approximately 0.5 g of sample was digested in 5 ml HNO_3, 3 ml H_2O_2, and 5 ml deionized H_2O for MAE-H and in 8 ml EDTA solution for MAE-EDTA. Certified plant reference materials (CRMs) were used for comparison of recovery rates from different extraction protocols. Thereby, the applicability of both MAE-H and MAE-EDTA procedures could be demonstrated.

For 58 plant samples MAE-H showed the same extraction yields as CE in the determination of trace metal contents of the investigated elements in plant samples. MAE-EDTA gave similar values when compared to MAE-H and highly linear relationships were found for determination of Cd, Mn, Pb and Zn amounts. The recoveries for the CRMs were within the range 89.6-115%.

Finally, strategic characteristics of MAE-EDTA for determination metal contents (Cd, Mn, Pb, Zn) in plant samples are: (i) applicability to a large set of plant samples; (ii) usage of minimum acid volume and minimum amount of sample for digestion; and (iii) composition of fast, safe and environmental friendly extraction procedure.