

## Assessment of Heavy Metal Pollution in Republic of Macedonia Using a Plant Assay

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**Abstract** Different plant organs (leaves, flowers, stems, or roots) from four plant species—*Urtica dioica* L. (*Urticaceae*), *Robinia pseudoacacia* L. (*Fabaceae*), *Taraxacum officinale* (*Asteraceae*), and *Matricaria recutita* (*Asteraceae*)—were evaluated as possible bioindicators of heavy-metal pollution in Republic of Macedonia. Concentrations of Pb, Cu, Cd, Mn, Ni, and Zn were determined in unwashed plant parts collected from areas with different degrees of metal pollution by ICP-AES. All these elements were found to be at high levels in samples collected from an industrial area. Maximum Pb concentration was  $174.52 \pm 1.04 \text{ mg kg}^{-1}$  in *R. pseudoacacia* flowers sampled from the Veles area, where lead and zinc metallurgical activities were present. In all control samples, the Cd concentrations were found to be under the limit of detection (LOD  $<0.1 \text{ mg kg}^{-1}$ ) except for *R. pseudoacacia* flowers and *T. officinale* roots. The maximum Cd concentration was  $7.97 \pm 0.15 \text{ mg kg}^{-1}$  in *R. pseudoacacia* flowers from the Veles area. Nickel concentrations were in the range from  $1.90 \pm 0.04$  to  $5.74 \pm 0.03 \text{ mg kg}^{-1}$ . For

all control samples, results for Zn were low, ranging from  $10.2 \pm 0.05$  to  $38.70 \pm 0.18 \text{ mg kg}^{-1}$ . In this study, it was found that the flower of *R. pseudoacacia* was a better bioindicator of heavy-metal pollution than other plant parts. Summarizing the results, it can be concluded that *T. officinale*, *U. dioica*, and *R. pseudoacacia* were better metal accumulators and *M. recutita* was a metal avoider.

Pollution of the environment refers to pollution due to the release (into any environmental medium) from any process of substances which are capable of causing harm to humans or any other living organisms (UK Environmental Protection Act 1990). Monitoring the pollution status of the environment using plants is one of the main topics of environmental biogeochemistry (Diatta et al. 2003). The interest in phytoindicators arises from the fact that plants quickly react to chemical changes in the environment and are affected by a wide array of substances that contaminate air, water, and soil (Kabata-Pendias and Pendias 1992).