

Using portable XRF devices for quick and low-cost measurement of metal content in soils, plants and mushrooms in peri-industrial areas of Wallonia (southern Belgium)

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In Belgium, as in many parts of the world, atmospheric depositions of smoke and dust from historical industrial, mining and smelting activities have strongly impacted soil metal concentrations in large areas. This high soil metal content consequently induces high metal concentrations in plants and mushrooms that may cause further toxicity for humans and/or farm animals. Managing this environmental and human risk requires first to determine the level of metal concentration in the different environment compartments. Here we assess the capability of portable X-ray fluorescence (pXRF) to measure metal concentrations in soils, plants and mushrooms. Plants, mushrooms and topsoil horizons were sampled from several sites located both in urban and peri-industrial areas and metal concentrations were determined using a Niton XI3t GOLDD+ pXRF device. Two sample preparation protocols were used: an "in-situ" protocol, which consists of direct measurement on fresh samples, and a "powder" protocol, which consists of drying and crushing the samples prior to analysis. Measurement results obtained by pXRF were compared to those obtained by classical methods (acid digestion and ICP analysis).

This study shows that pXRF devices may represent a good alternative to the classical methods for a quick and low-cost metal content measurement in soils, plants and mushrooms. For soil samples, both the in-situ and the powder protocols performed using pXRF allowed us to accurately reproduce the aqua regia metal content. For plant and mushroom samples, only the powder protocol provided consistent results. This is probably due to the high water content (80% - 97%) of the fresh plant and mushroom samples. In the mushroom samples, the As, Co, Cr, Ni and Pb contents were generally close to the quantification limits, but for Cd, Cu and Zn, high contents were observed and for these elements, the classical method contents were accurately reproduced by pXRF. The Cd content of most of the sampled mushrooms was higher than the EU food quality standard values (EEC 1881/2006).