

# Quantifying Heavy Metals in Vegetables at Low Concentrations Using WD-XRF and ED-XRF

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Sample preparation techniques, measurement routines and custom calibrations were developed and optimized for the quantification of lead and additional heavy metals in dried and wet consumable vegetable tissues via WD-XRF and/or portable ED-XRF spectroscopy. After mitigating matrix influences fundamental to XRF quantification of heavy metals in a carbon matrix, the custom measurement and calibration routines were capable of detecting and quantifying Pb in dried prepared vegetable samples at concentrations relevant to the World Health Organization. The viability of each calibration was evaluated with measurements of vegetables grown in metals-rich garden soil collected from residential properties. Although robust calibrations for dried vegetables were obtained with WD-XRF, the slight compromise in the precision and accuracy of measurements with portable ED-XRF is offset by the portability of this technology. Heavy metal concentrations in wet coarsely-homogenized raw consumable vegetable tissues were quantified; however, further work is needed to test the viability of ED-XRF calibrations.

XRF measurement routines were then used to measure heavy metals in a variety of vegetables grown in metals-rich soil obtained from residential and industrial properties in the City of Milwaukee, Wisconsin. Routines were also used to quantify heavy metals in domestically-grown fresh produce and internationally-sourced prepared foods purchased from grocery stores located in the City of Milwaukee, Wisconsin.