

Development of a multi-elemental method for foodstuffs analysis by inductively coupled plasma-mass spectrometry following microwave digestion and validation by using the accuracy profile approach

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This work describes an optimization and validation process for the simultaneous determination of 35 elements - lithium (Li), boron (B), sodium (Na), magnesium (Mg), aluminium (Al), potassium (K), calcium (Ca), titanium (Ti), vanadium (V), chrome (Cr), iron (Fe), manganese (Mn), cobalt (Co), nickel (Ni), copper (Cu), zinc (Zn), gallium (Ga), germanium (Ge), arsenic (As), selenium (Se), strontium (Sr), molybdenum (Mo), rhodium (Rh), silver (Ag), palladium (Pd), cadmium (Cd), tin (Sn), antimony (Sb), tellurium (Te), barium (Ba), platine (Pt), mercury (Hg), thallium (Tl), lead (Pb) and uranium (U) - in food samples by inductively coupled plasma-mass spectrometry (ICP-MS) after closed-vessel microwave digestion or multiwave with pressurized digestion cavity. In order to improve the limits of quantification of certain elements for risk assessment in the context of the third French Total Diet Study (3rdTDS), the analytical conditions of the multi-elemental method were optimized.

The method was validated based on the accuracy profile approach according to the NF V03-110 French standard, which takes into account the simultaneous assessment of the accuracy and precision of the method. The accuracy profile is an expression of the combination of the systematic (trueness) and the random error (repeatability and/or intermediate precision) for a series of analyst's levels in various matrices in range of concentrations called validity domain. For this purpose, five to six measurement series were repeated in duplicate on different days, over a timespan of three months for constructing the accuracy profile with six levels of concentration.

Several performance criteria such as limits of quantification (LOQ), specificity, linearity, precision under repeatability conditions, intermediate precision reproducibility with the use of the accuracy profile. Furthermore, the method accuracy was assessed by means of several external quality controls (EQC).

Results indicate that this method could be used for the determination of these 35 essential and non-essential elements in foodstuffs at trace and ultra-trace levels, including for 3rd TDS, with acceptable analytical performance.

Keywords: trace elements, food, microwave extraction, ICP-MS, Total Diet Study

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