Fast screening for nutrition-relevant and toxic trace elements in plant and fish material by TXRF spectroscopy

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The accurate analysis of nutrition-relevant and toxic trace elements is of crucial importance. The human dietary micronutrients, which are required in very small amounts, include trace elements as V, Cr, Cu, Mn, Fe, Ni, Zn, Se, As as well as several vitamins. In order to ensure that dietary intake is providing adequate levels of essential elements, these trace elements must be determined accurately. In addition, contamination by toxic elements like Hg, Pb and Tl, e.g. from industrial or mining sources or plant treatment with herbizides and fungizides, is an analytical task for trace elemental analysis.

The most common analytical techniques for the analysis of trace elements in plant and fish material are Inductively-Coupled Plasma Atomic Emission Spectroscopy (ICP-AES) [1] and Inductively-Coupled Plasma Mass Spectrometry (ICP-MS) [2]. But as these analytical techniques demand a laborious and time-consuming sample preparation, their suitability for a fast screening of large sample batches is limited. In addition, the requirements for the laboratory environment and the need for costly consumables may not allow the routine use in laboratories with limitations in facilities, supplies and budget.

In this paper the opportunities and limitations of total reflection X-ray fluorescence (TXRF) analysis for the quantification of nutrition-relevant and toxic trace elements are summarised. When analysing four plant reference standards (NIST 1515; apple leaves, NIST 1547; peach leaves, NIST 1572, citrus leaves, NIST 1573a, tomato leaves) and one fish reference standard (DORM-3), the measured concentrations were in good concordance with the reference values. The recovery of the micro- and macronutrients in the plant standard samples was in the range of 85 to 115%. For the fish standard satisfying recoveries were achieved for Cr, Fe, Ni, Cu, Zn, As and Pb. Concentrations and detection limits of other elements will be also shown. In addition different sample preparation methods for fast element screening of food material in comparison with ICP-MS data will be discussed.

Literature

[1] Carrhilho, E. N. et al (2002), J. Agric. Food Chem. 50, 15, 4164–4168
[2] Koplík, R., Čurdová, E., Suchánek, M. (1997), Fresenius J. Anal. Chem. 360, 449-451