

High-Resolution ICP-MS

Lower Limits of Quantification for Lead, Cadmium, Mercury, Arsenic and Antimony

The heavy metals lead, cadmium, mercury as well as arsenic are omnipresent within our environment – not least due to various industrial processes. They find their way into the food chain by intake through water and soil as well as through atmospheric sediments. Main intake sources are fish and sea food, fruits and vegetables, nuts and cereals. In case of lead, drinking water is also of major importance. Since the toxicological effects of heavy metals and arsenic on babies and infants are of special relevance, also baby food is in the spotlight.



Toxicology

Lead has a very low acute toxicity. Most essential longterm effects are its neurotoxicity for infants and its effects on the cardiovascular tissue of adults. The provisional tolerable weekly intake (PTWI) of 25 µg/kg body weight, established by JECFA, was found unsuitable by the European Food Safety Authority (EFSA) in 2010.

Cadmium is primarily nephrotoxic and may cause bone demineralisation. In 2009, the EFSA has lowered the TWI to 2.5 µg/kg body weight.

Mercury mainly occurs as methyl mercury in fish and seafood, and is thus extremely toxic on the nervous system. Other foods usually contain less toxic inorganic mercury. In 2004, the EFSA has fixed a PTWI of 1.6 µg/kg body weight.

Arsenic also occurs in organic and inorganic compounds, of which the latter is clearly more toxic and found responsible for cancer of skin, lungs and the urinary tract. In 2009, the EFSA recommended to reduce exposition to inorganic arsenic.

Regulatory Provisions

In Regulation (EC) No. 1881/2006, the EU-Commission has laid down maximum limits for lead, cadmium, mercury and inorganic tin. To take into account the reduced TWI for cadmium set up by EFSA in 2009, the existing maximum levels for some fish species were reduced and new maximum levels were introduced for cocoa and chocolate products (from 2019) and food for infants and toddlers (2015).

Sample taking procedures and analytical methods for metals are harmonised in Regulation (EC) No. 333/2007.

Additionally, the regulations for drinking water as well as the one for mineral and table water set up maximum values for a number of metals and elements.

Analysis

Our experts from the Competence Centre for Inorganic Contaminants have longterm experience in analysing metals and elements. Along with classical atomic absorption spectrometry (AAS) with graphite furnace or respectively cold vapor, ICP-OES and ICP-MS-techniques are most frequently in use. Due to the introduction of the **high-resolution ICP-MS**, lead, cadmium, mercury, arsenic and antimony may now be analysed more selectively and even with a much higher sensitivity. The significantly reduced limits of quantification are displayed in Table 1. Thus, the HR-ICP-MS allows a safe revision of already planned and potential further reductions on maximum levels of metals and elements in food.

Naturally, the differentiation of organic and inorganic arsenic as well as the determination of a number of further metals and elements via AAS and ICP-techniques are part of our portfolio.

Tab. 1: Limits of Quantification [mg/kg] for the analysis of lead, cadmium, mercury, arsenic and antimony using different analytical methodologies

Metal/ Element	Conventional Analysis of Metal-/ Elements	HR-ICP-MS
Lead	0.5 – 0.02	0.001
Cadmium	0.1 – 0.005	0.001
Mercury	0.005	0.001
Arsenic	0.5 – 0.05	0.001
Antimony	0.5 – 0.1	0.001