



Inorganic Arsenic

New IC-ICP-MS method for the analysis of arsenic species with low limits of quantification

Arsenic is a widespread element, present in soil, groundwater, plants, seawater and animals due to natural occurrence as well as anthropogenic contaminations. In food, arsenic is found as organic as well as inorganic compounds. Inorganic arsenic compounds (iAs) are classified as carcinogenic. The intake of inorganic arsenic should be minimised.

Occurrence

Seafood and fish have been identified as major source of arsenic in the human diet and in animal feed. In seafood and fish, arsenic is present predominantly in the organic forms of arsenobetaine and arsenocholine, compounds being less toxic.

The main sources of inorganic arsenic intake across all age groups are cereals and cereal based products (mainly rice), food and bottled water. In 2021, the European Food Safety Authority (EFSA) published an exposure assessment, identifying biscuits, rusks, and cookies for children as being most critical.

Toxicity

Most organic arsenic compounds are considered of low toxicological relevance. Inorganic arsenic compounds are predominantly bound in the oxidation state +3 (As^{III}) or +5 (As^{V}) in thiocomplexes or are present as oxoanions arsenite (As^{III}) and arsenate (As^{V}).

Already in 2009, the EFSA established a benchmark dose (BMD) of 0.3 – 8 $\mu\text{g}/\text{kg}$ body weight/day for increased risk for lung, skin and bladder cancer and skin lesions. In its new draft update of this opinion published in 2023, a lower reference point (RP) of 0.06 μg iAs/kg body weight/day is already established as the dose having a small but measurable adverse effect.

In addition to the types of cancer already described in 2009, chronic kidney and respiratory diseases, spontaneous abortion, stillbirths, infant mortality and neuro-developmental effects are now attributed to iAs.

Regulatory Provisions

According to Regulation (EU) 2023/915 on Maximum Levels of Contaminants in Food maximum levels exist for inorganic arsenic as sum of As^{III} and As^V in rice and rice products including rice-based drinks, fruit juices as well as baby and infant food. In addition, a maximum level for total arsenic in salt exists.

Recommendation (EU) 2015/1381 requests member states to monitor arsenic and arsenic species in a multitude of additional foodstuffs.

For animal feed, maximum limits for arsenic are established for a number of feed commodities by Directive 2002/32/EC of the European Parliament and of the Council of 7th May 2002 on undesirable substances in animal feed.

Recommendation 2002/C206/01 requests the monitoring of the presence of inorganic arsenic in individual and compound feed.

Analysis

Eurofins offers the determination of total arsenic in food and feed using different techniques, such as Graphite-Furnace-Atomic-Absorption-Spectrometry (GFAAS), Optical Emission Spectrometry with Inductively Coupled Plasma (ICP-OES), Inductively Coupled Plasma-Mass Spectrometry (ICP-MS) or ICP-MS/MS.

For the determination of inorganic arsenic, Eurofins now offers with IC-ICP-MS a new and particularly sensitive method. The standard method DIN EN 15802:2016 is used in a slightly

modified form. After acid extraction, organic and inorganic arsenic species are separated by ion chromatography (IC) and detected by ICP-MS. The sum of inorganic As^{III} and As^V is reported. So far, the method is available for cereals and cereal products, particularly rice, wheat and cereal based baby foods.

Validation of other matrices such as milk-based infant formula and complementary foods for infants and young children is currently in progress. Furthermore, the quantification of methylated arsenic species is planned.

