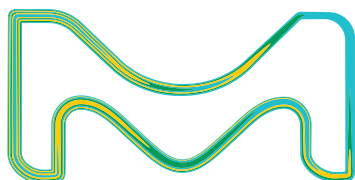


Detecting Heavy Metals

Key Testing Solutions for Food and Beverage

- Arsenic, Cadmium, Lead, Mercury
- Workflows for ICP and AAS analyses
- Testing of ingredients and finished products



Regulation of Heavy Metals

Health risks in food and beverages



The insidious thing about heavy metal food poisoning is that toxic levels can be built up over a long time from a wide variety of sources. Whether it be from arsenic, cadmium, mercury, lead, or others, symptoms present themselves only late in the exposure. With no single geographic or species source of contamination, typically low concentrations in any given food, and people's varied diets, it is more important to avoid even minute contaminations in food sources. Because of this prolonged trace exposure, regular high-sensitivity testing for these metals is essential in key points of the food supply chain. As a result, the global trend is for increased frequency of testing.

Long-term safety remains a question of exposure levels (concentration over time) despite the regularity by which the major food and beverage agencies (like those listed below) regulate heavy metals in consumer products and feed.

- World Health Organization (WHO)
- United States Food and Drug Administration (USFDA)
- United States Environmental Protection Agency (USEPA)
- European Commission (EC-EFSA)
- China Food and Drug Administration (CFDA)
- Food Safety and Standards Authority of India (FSSAI)

The challenge is that "heavy" metals (usually classified as possessing a density greater than 3.7 g/cm^3) are found at typically nonhazardous levels in a wide variety of food types and geographies. However, significant single, or short-time exposures have been increasingly reported and global concern for increased health risk is rising.

From a US Consumer Reports analysis of 50 nationally distributed, packaged baby foods

50
products

had at least one of the more health damaging metals (cadmium, inorganic arsenic, or lead)

68%
tested products

had at least one heavy metal at a seriously high level

15%

would pose potential health risks to children if exposed with one or fewer servings per day

The report found organic baby foods offered no better protection from heavy metal exposure.

Key testing solutions

Detecting heavy metals in food and beverages

Recent advances in analytical technologies have allowed much improved sensitivity, efficiency and availability of heavy metal testing globally. Three of the most commonly used technologies involve the use of either atomic absorption spectrophotometry (AAS), inductively coupled plasma-optical emission spectroscopy (ICP-OES), or inductively coupled plasma-mass spectrometry (ICP-MS); which are vast improvements over older, colorimetric techniques (Jackson & Punshon, 2015). These modern techniques are pushing the limits of sensitivity for heavy metal detection but can be significantly influenced by sample matrix, and require extensive operational training, high-quality reagents and purified water.

We are committed to advancing global heavy metal detection by providing regulatory knowledge, expertise and high quality products for the entire heavy metals analysis workflow. Everything from Millipore filters, Supelco reagents and reference materials, and Milli-Q water solutions will ensure success with the demands of your specific application.

key ingredients

- ✓ Elemental Trace Detection
- ✓ Heavy Metal Analysis
- ✓ Your Dedication to Safety

SigmaAldrich.com/FoodTestingHero



Sample Preparation for AAS and ICP Analysis

Your AAS and ICP workflows require high quality products you can rely on (see **Figure 1**). Our scientists and subject matter experts have developed such products to meet these needs and provide you the key tools for your analytical methods.

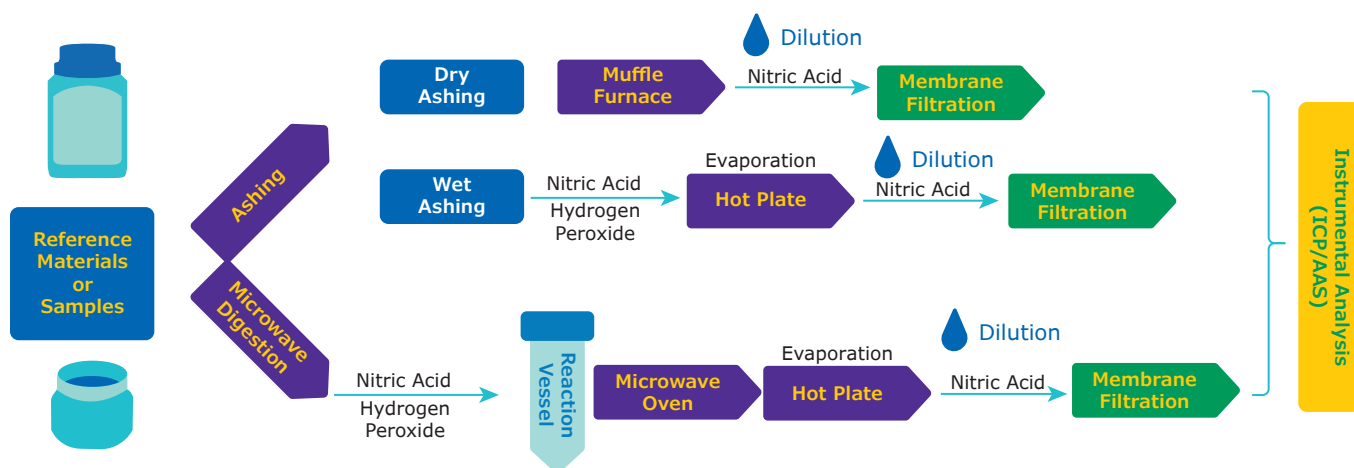


Figure 1. displays the AAS and ICP analytical sample preparation workflow. AAS and ICP are the most common technologies used for detecting heavy metals.

Sample Preparation Products

Product Category and Description	Application	Cat. No.
Reagents		
Water ultrapure from Milli-Q® IQ system	Dilution and cleaning of samples and reagents	Refer to page 8
Water Ultrapur, deionized, 500mL or 1L	Dilution and cleaning of samples and reagents, highest purity, tested for ppt level of residual elements, best for ICP-MS	1.01262.0500
		1.01262.1000
Water, ACS grade for trace analysis or Suprapur®	Dilution and cleaning of samples and reagents	14211-1L-F, 1.00473.5000
		00612-2.5L 00612-5L
Nitric acid 60% Ultrapur	Digestion of samples and dissolution of elemental standards and analytes	1.01518.0250
		1.01518.0500
		1.01518.1000
		1.00441.0250
Nitric acid 65% Suprapur®		1.00441.1000
		1.00456.1000
Nitric acid 65% Emsure®		1.00456.2500
		1.00456.2510
		1.00456.9026

Sample Preparation Products

We offer the necessary reagents for sample preparation in different grades to meet your needs. Choose Ultrapur for ultra-trace analysis (ppt) or Suprapur® for trace analysis (ppb). EMSURE® is a cost-effective option that offers extensive impurity profiling and very low ppm level purity specifications.

Sample Preparation Products

Product Category and Description	Application	Cat. No.
Reagents		
		1.01514.0250
Hydrochloric acid 30%, Ultrapur		1.01514.0500
		1.01514.1000
	Digestion of samples and dissolution of elemental standards and analytes	1.00318.0250
Hydrochloric acid 30%, Suprapur®		1.00318.0500
		1.00318.1000
		1.00318.2500
		1.05589.0250
Sodium hydroxide solution 32%, Suprapur®		1.05589.0500
	For evaporation scrubber	1.05589.1000
		1.05589.2500
		1.11360.2500
Sodium hydroxide solution min. 45%, for analysis EMSURE®		1.11360.9025
Hydrogen peroxide 31% Ultrapur		1.06097.1000
		1.07298.0250
Hydrogen peroxide 30% Suprapur®		1.07298.0500
	Facilitation of sample decomposition during the acid digestion	1.07298.1000
		95321-100ML
Hydrogen peroxide >30% for trace analysis		95321-500ML
Membrane Filtration		
MILLEX®-LCR Syringe Filter, PTFE membrane, Hydrophilic, Non-sterile, 0.45 µm pore size, 13 mm diameter		SLCRX13
MILLEX®-LCR Syringe Filter, PTFE Membrane, Hydrophilic, Non-sterile, 0.45 µm pore size, 33 mm diameter		SLCR033NS
MILLEX® Syringe Filter, Durapore® (PVDF) Membrane, Hydrophilic, Non-sterile, 0.45 µm pore size, 33 mm diameter	Filtration of residuals and tissues generated from the acid digestion	SLHV033NS
Fluoropore®, PTFE Membrane Filter, Hydrophobic 0.45 µm pore size, 47 mm diameter		FHLP04700
Durapore® PVDF Membrane Filter, Hydrophilic 0.45 µm, 47 mm diameter		HVLP04700
Omnipore PTFE Membrane Filter, Hydrophilic 0.45 um pore size, 47 mm diameter		JHWP04700
Samplicity® G2 Filtration System, Glossy Green	Automated vacuum-driven system to enhance the filtration efficiency	SAMP2SYSG
Samplicity® G2 Filtration System, Blue		SAMP2SYSB
MILLICUP-FLEX, 47 mm Disposable Filtration Unit	Disposable single-use sample cup for filtration system	MCFLX4710
MILLICUP™-FLEX, 47 mm Disposable Filtration Kit		MCFLX4702
Millipore® All-Glass Filter Holder - Kit	Sample cup for filtration system	XX1514700
Chemical Duty Pump, 100 V/50–60 Hz	Vacuum pump	WP6110060

Reference Materials

Certified reference materials for ICP-OES and ICP-MS (*TraceCERT®* and *Certipur®*)

We offer a large range of single element certified reference standard solutions, as well as mixes in various concentrations, suitable to detect various regulated metals in food and beverages.

Our reference materials are certified according to ISO 17034 and ISO/IEC 17025. Every reference material certificate includes the certification report and is issued according to the ISO Guide 31 guidelines. To guarantee top reliability of the values, all certified reference solutions are traceable to specified NIST or BAM SRMs.

Single solutions for ICP-MS

All concentrations are 1 mg/L, except for (42058) Mercury solution at 10 mg/L and (51873) Thallium solution at 1000 mg/L

Element	Diluent	Matrix	Cat. No.
Arsenic, <i>TraceCERT®</i>	Nitric acid	Muscle (beef, pork, poultry, fish), processed products; baby food	75016-100ml
Cadmium, <i>TraceCERT®</i>	Nitric acid	Muscle (beef, pork, poultry, fish), processed products; baby food	12313-100ml
Cobalt, <i>TraceCERT®</i>	Nitric acid	Muscle (beef, pork, poultry, fish), processed products	41798-100ml
Lead, <i>TraceCERT®</i>	Nitric acid	Muscle (beef, pork, poultry, fish), processed products; baby food	75015-100ml
Manganese, <i>TraceCERT®</i>	Nitric acid	Muscle (beef, pork, poultry, fish), processed products	42058-100ml
Mercury, <i>TraceCERT®</i> , 10 mg/L	Nitric acid	Baby food	89459-100ml
Molybdenum, <i>TraceCERT®</i>	Water	Muscle (beef, pork, poultry, fish), processed products	04488-100ml
Selenium, <i>TraceCERT®</i>	Nitric acid	Muscle (beef, pork, poultry, fish), processed products	56544-100ml
Thallium, <i>TraceCERT®</i> 1000 mg/L	Nitric acid	Muscle (beef, pork, poultry, fish), processed products	51873-100ml
Thallium, <i>Certipur®</i>	Nitric acid	Muscle (beef, pork, poultry, fish), processed products	1.70359.0100
Scandium, <i>TraceCERT®</i>	Nitric acid		67464-100ml
Indium, <i>TraceCERT®</i>	Nitric acid		56875-100ml
Yttrium, <i>TraceCERT®</i>	Nitric acid		01357-100ml



SigmaAldrich.com/reference-materials

Single solutions for ICP-OES

All concentrations are 1000 mg/mL

Element	Diluent	Matrix	Cat. No.
Aluminum, <i>TraceCERT</i> ®	Nitric acid	Muscle (beef, pork, poultry, fish), processed products	61935-100ml
Aluminum, Certipur®	Nitric acid		1.70301.0100
Barium, <i>TraceCERT</i> ®	Nitric acid		59943-100ml
Barium, Certipur®	Nitric acid		1.70304.0100
Boron, <i>TraceCERT</i> ®	water		01932-100ml
Boron, Certipur®	water		1.70307.0100
Chromium, <i>TraceCERT</i> ®	Nitric acid		74582-100ml
Chromium, Certipur®	Nitric acid		1.70312.0100
Copper, <i>TraceCERT</i> ®	Nitric acid		58921-100ml
Copper, Certipur®	Nitric acid		1.70314.0100
Iron, <i>TraceCERT</i> ®	Nitric acid		43149-100ml
Iron, Certipur®	Nitric acid		1.70326.0100
Nickel, <i>TraceCERT</i> ®	Nitric acid		28944-100ml
Nickel, Certipur®	Nitric acid		1.70336.0100
Strontium, <i>TraceCERT</i> ®	Nitric acid		75267-100ml
Strontium, Certipur®	Nitric acid		1.70354.0100
Vanadium, <i>TraceCERT</i> ®	Nitric acid		18399-100ml
Vanadium, Certipur®	Nitric acid		1.70366.0100
Zinc, <i>TraceCERT</i> ®	Nitric acid		18562-100ml
Zinc, Certipur®	Nitric acid		1.70369.0100

Single solutions & Mixes for ICP-MS/ICP-OES

Description	Diluent	Matrix	Cat. No.
Bismuth, <i>TraceCERT</i> ®, 1000 mg/L	Nitric acid		05719-100ml
Germanium, <i>TraceCERT</i> ®, 1000 mg/L	Nitric acid		05419-100ml
Heavy metal mix IX, <i>TraceCERT</i> ®	As, Cd, Hg, Pb: each 100 mg/L in 12% nitric acid		89471-100ml



Ultrapure water without compromise for trace metal analyses

Water plays an important role in elemental analysis. Selecting a water purification system delivering freshly purified ultrapure water will ensure optimal method sensitivity, as well as reliable and accurate results.

Milli-Q® IQ 7003/05/10/15 Pure and Ultrapure Water Systems

- Optimized combination of purification technologies delivers consistent and reliable water quality
- Intuitive touchscreens allow easy system monitoring, navigation and control
- Easy-to-use dispensers give convenient access to purified water
- Advanced data management and traceability allows easy access to water quality and system history

Milli-Q® IQ Element Water Purification and Dispensing Unit

- Ultrapure water suitable for the most stringent trace elemental analyses by ICP-MS or GF-AAS
- Extremely low levels of elemental contaminants, from single ppt to sub-ppt detection levels
- Footswitch and dispenser provide hands-free water delivery to reduce risk of contamination
- Compact design easily integrates into your space

Water solutions

Cat. No.

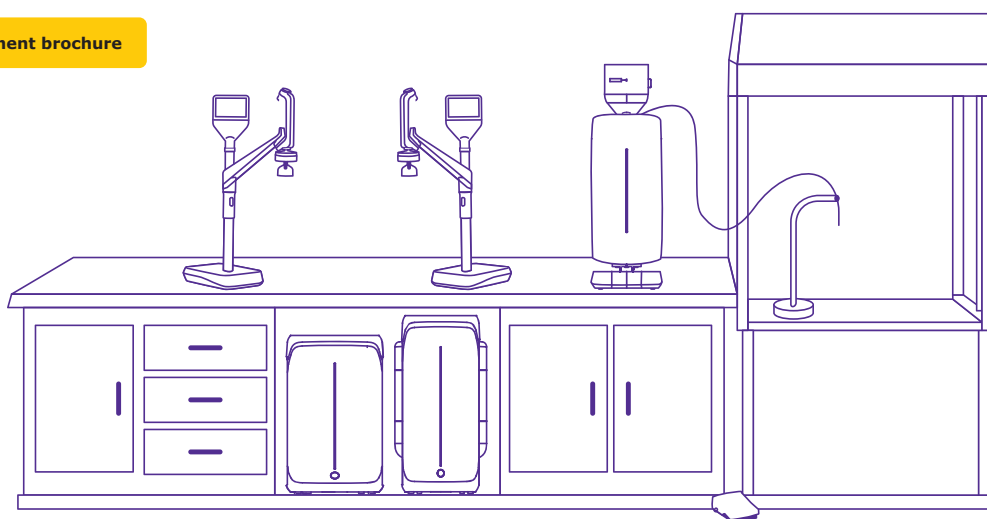
Milli-Q® IQ 7003/05/10/15 pure & ultrapure systems

ZIQ7003T0 / ZIQ7005T0 / ZIQ7010T0 / ZIQ7015T0

Milli-Q® IQ Element purification & dispensing unit

ZIQELEMTO

[View the Milli-Q® IQ Element brochure](#)



Milli-Q®

Lab Water Solutions

SigmaAldrich.com/milliqbenchtop

Labware & Accessories

Labware & Accessories	Cat. No.
Centrifuge tubes polypropylene 50 mL	T2193
Laboratory glass bottles 100 mL	Z232173
Pipette 0,5-10 µL	EP4924000223
Pipette 10-100 µL	EP4924000258
Pipette 100-1000 µL	EP4924000282
Pipette 500-5000 µL	EP4924000304
Variable volume pipette, pk 6; 0.5-10 µL, 10-100 µL, 30-300 µL, 100-1000 µL	Z740363
Pipette tips 0,1-20 µL box	Z640204
Pipette tips 2-200 µL box	Z640220
Pipette tips 50-1000 µL box	Z640247
Pipette tips 100-5000 µL box	Z640271
Coors™ porcelain crucible, High form, capacity 30 mL	Z247138
Coors™ porcelain crucible, High form, capacity 50 mL	Z247146
Coors™ porcelain crucible, High form, capacity 100 mL	Z247154
Coors™ porcelain crucible cover, pk 12	Z247227-1PAK



Looking for Rapid Analysis?

Our selection of laboratory products, for rapid heavy metals testing include MQuant® test strips and Spectroquant® photometric test kits.

MQuant® Test Strips provide quick and low-priced analysis, that can be easily transported and operated in the field. Photometric testing with the Spectroquant® system includes instruments, guided sample preparation, a comprehensive range of easy-to-use test kits, and an end-to-end Analytical Quality Assurance.

Regardless of your application, our instruments, kits, and test strips are sure to provide a rapid and accurate analysis.

Rapid Chemical Testing Solutions	Cat. No.
Arsenic Test, colorimetric, As 0.02-3 mg/L, MQuant® test strips	1.17917.0001
Arsenic Test colorimetric, 0.005-0.50 mg/L (As), MQuant® test strips	1.17927.0001
Lead Test, colorimetric, 20-500 mg/L (Pb), MQuant® test strips	1.10077.0001

Photometric Systems and Testing Solutions	Cat. No.
Absorption Tube for Arsenic joint ST/NS29 for use with Spectroquant®	1.73501.0001
Arsenic Test, photometric, 0.001-0.100 mg/L (As), Spectroquant®	1.01747.0001
Arsenic Reagent 2: Sulfuric acid 95-97% for analysis EMSURE® ISO	1.00731.1000
Arsenic Reagent 7: Zinc granular for analysis, particle size about 3-8mm EMSURE® ISO	1.08780.0500
Cadmium Test, photometric, 0.002-0.500 mg/L (Cd), for use with Spectroquant®	1.01745.0001
Chromate Test, photometric, 0.010-3.00 mg/L (Cr), 0.02-6.69 mg/L (CrO4), for use with Spectroquant®	1.14758.0001
Crack Set 10C	1.14688.0001
Iron Test, photometric, 0.010-5.00 mg/L (Fe), for use with Spectroquant®	1.00796.0007
Lead Test, photometric, 0.010-5.00 mg/L (Pb), for use with Spectroquant®	1.09717.0001
Nickel Test, photometric, 0.02-5.00 mg/L (Ni), for use with Spectroquant®	1.14785.0007
Prove 100 Spectroquant® spectrophotometer	1.73016.0001
Prove 300 Spectroquant® spectrophotometer	1.73017.0001
Prove 600 Spectroquant® spectrophotometer	1.73018.0001
Thermoreactor TR320	1.71200.0001
Zinc Cell Test, photometric, 0.025-1.000 mg/L (Zn), Spectroquant®	1.00861.0001



More test strips on [SigmaAldrich.com/test-strips](https://www.sigmaaldrich.com/test-strips)

More photometric tests on [SigmaAldrich.com/photometry](https://www.sigmaaldrich.com/photometry)

connect your lab and ensure data integrity

In today's fast paced environment where routine testing needs to be as efficient as possible - fast, accurate and secure documentation, and data transfer is increasingly important.

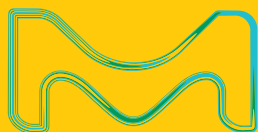
The latest digital solutions from the Supelco® portfolio can simplify your daily analytical workflow while maintaining the fidelity of your data.

- 2D Smart Labels
- Smart Titration Chemicals
- Smartphone App for Nitrate and pH Testing
- Spectrophotometer Data Transfer & LIMS Integration
- Sample Smarter with Supelco® SPME Fibers
- Proficiency Testing (PT) Portal



Let us help you to fulfill your regulatory requirements by securing and streamlining your digital data transfer.

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Analytical Products

MilliporeSigma
400 Summit Drive
Burlington, MA 01803

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Scan the QR code or follow the below link to contact an analytical specialist to discuss your food and beverage heavy metal testing needs.

SigmaAldrich.com/foodbev-contact

To place an order or receive technical assistance

Order/Customer Service: **SigmaAldrich.com/order**

Technical Service: **SigmaAldrich.com/techservice**

Safety-related Information: **SigmaAldrich.com/safetycenter**

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