

Testing Trace Metals in Edible Oils

ICP-OES Analysis Using Aqueous CRMs and ASOSolv™

Summary

Inorganic Ventures has extended its hybrid aqueous CRM/organic solvent methodology to the analysis of trace metals in edible oils by ICP-OES. This approach uses aqueous inorganic CRMs diluted in ASOSolv™, to calibrate for 32 elements relevant to edible oil safety and quality. The method is designed to meet the low detection limit requirements imposed by international regulatory action limits for heavy metals in food-grade oils. ASOSolv™'s trace metallic impurity (TMI) profile and ultra-low background for regulated analytes make it uniquely suited to this application, where solvent blank contributions can be the limiting factor in achieving low detection limits.

Background

Regulatory bodies worldwide set strict action limits for heavy metals in edible oils, reflecting the public health significance of dietary exposure to contaminants such as arsenic, cadmium, lead, and mercury.

Element	Action Limits (ppm)
As	0.10
Cd	0.05
Fe	1.0–1.5
Hg	1.0
Pb	0.08–0.10
Sn	15–20
Zn	1.0–1.5

Table 1 Regulatory action limits for heavy metals in edible oils

Achieving these detection limits requires not only sensitive instrumentation but also diluents and calibration standards with rigorously controlled trace element backgrounds. Traditional organometallic oil standards and many commercial solvents are not well-suited to this task: their TMI profiles are not reliable, and background contributions from the diluent can elevate detection limits or create false positives for regulated analytes.

Why Select ASOSolv™ for Edible Oil Analysis?

Trace Metallic Impurity Data Provided for Each Lot

Every lot of ASOSolv™ is analyzed by ICP-OES for 66 elements. The lot-specific Certificate of Analysis (CoA) documents the TMI data for each element. For the regulated heavy metals of primary concern in edible oils, lot W2-MEB757963 of ASOSolv™ demonstrated the following TMI values:

Element	ASOSolv™ TMI (µg/mL)	Element	ASOSolv™ TMI (µg/mL)
As	<0.021	Pb	0.022
Cd	<0.00015	Sn	<0.0055
Fe	0.0026	Zn	0.013
Hg	0.0076	S	<0.0065

Table 2 ASOSolv™ TMI values for key regulated analytes (Lot W2-MEB757963)

These sub-ppb to low-ppb TMI levels for As, Cd, Fe, Hg, Pb, Sn, and Zn confirm that ASOSolv™ does not impose a meaningful blank contribution at the concentrations relevant to edible oil regulatory testing. The solvent blank of ASOSolv™ is well below the method detection limits achieved in this application, meaning the detection limits shown in the results section reflect true instrument capability rather than solvent background.

Method Review

Calibration Standards

The ICP-OES is calibrated for 32 elements using three sets of aqueous calibration standards diluted in ASOSolv™. Standards are split for elemental stability and to minimize inter-element interferences. The matrix of the calibration standards is 1:10 w/w aqueous to organic solvent.

Sample Preparation

Edible oil samples are prepared using the same 1:10 w/w dilution with ASOSolv™ containing Co and Y internal standards. No acid digestion or ashing is required, making this a fast, direct analysis method compatible with high-throughput food testing laboratory workflows.



Results: Detection Limits & Spike Recoveries

Method detection limits (MDLs) and spike recovery data were generated using commercially available avocado oil and peanut oil as representative sample matrices. Samples were spiked at approximately 0.225 µg/g and analyzed to confirm accuracy across the full 32-element panel.

Element / Line (nm)	MDL (µg/g)	Action Limits (ppm)	Blank Oil Results (µg/g)	Spike Concentration (µg/g)	Blank Corrected Spike Recovery
Ag 328.068	0.0721	N/A	< MDL	0.2246	101%
Al 167.078	0.0123	N/A	< MDL	0.2246	106%
Bi 223.061	0.2302	N/A	< MDL	0.2246	83%
Cd 214.438	0.0062	0.05	0.0142	0.2246	95%
Cr 205.618	0.0218	N/A	0.0302	0.2246	94%
Cu 324.754	0.0543	N/A	< MDL	0.2246	97%
In 325.609	1.0186	N/A	< MDL	0.2246	53%
K 766.491	1.9295	N/A	< MDL	0.2246	9%
Mg 279.553	0.0207	N/A	< MDL	0.2246	93%
Na 589.592	0.3179	N/A	2.63	0.2246	95%
Ni 221.648	0.0273	N/A	< MDL	0.2246	99%
Pb 220.353	0.1079	0.08 - 0.10	< MDL	0.2246	84%
S 180.731	0.2562	N/A	1.62	0.2246	92%
Sr 407.771	0.0021	N/A	< MDL	0.2246	103%
B 249.677	0.0126	N/A	< MDL	0.2247	102%
Ba 233.527	0.0080	N/A	< MDL	0.2247	93%
Mo 202.095	0.0378	N/A	< MDL	0.2247	93%
P 213.618	0.1048	N/A	0.256	0.2247	86%
Sb 206.833	0.1746	N/A	< MDL	0.2247	86%
As 228.812	0.0644	0.10	< MDL	0.2251	88%
Be 234.861	0.0015	N/A	< MDL	0.2251	93%
Fe 238.204	0.0105	1.0 - 1.5	0.092	0.2251	91%
Hg 184.950	0.0160	1.0	< MDL	0.2251	113%
Li 670.780	0.0233	N/A	< MDL	0.2251	95%
Mn 257.611	0.0050	N/A	< MDL	0.2251	95%
Se 196.090	0.1145	N/A	< MDL	0.2251	57%
Si 251.612	0.0313	N/A	0.0759	0.2251	93%
Sn 189.991	0.0645	15 - 20	0.147	0.2251	94%
Ti 334.941	0.0026	N/A	< MDL	0.2251	99%
V 292.464	0.0186	N/A	< MDL	0.2251	96%
Zn 213.856	0.0802	1.0 - 1.5	< MDL	0.2251	87%
Zr 343.823	0.0201	N/A	0.0674	0.2251	98%

Table 3 Results summary for commercially available avocado oil

Key Highlights from Detection Limit Results

- **As:** MDL of 0.064 µg/g, well below the 0.10 ppm action limit.
- **Cd:** MDL of 0.006 µg/g, well below the 0.05 ppm action limit.
- **Fe:** MDL of 0.011 µg/g, well below the 1.0–1.5 ppm action limit.
- **Hg:** MDL of 0.016 µg/g, well below the 1.0 ppm action limit.
- **Pb:** MDL of 0.108 µg/g, at the margin of the 0.08–0.10 ppm action limit.
Longer read times recommended for labs requiring the lowest Pb detection limits.
- **Sn:** MDL of 0.065 µg/g, well below the 15–20 ppm action limit.
- **Zn:** MDL of 0.080 µg/g, well below the 1.0–1.5 ppm action limit.

Spike recoveries for most elements were between 85–107%, consistent with acceptable performance for a direct dilution method. Elements showing lower recoveries (In, K, & Se) reflect increased MDLs due to known spectral or matrix challenges and should be evaluated with method-specific calibration adjustments if quantitation of those elements is required.

Conclusions

The hybrid aqueous CRM/organic solvent approach using ASOSolv™ achieves method detection limits for regulated heavy metals in edible oils that are well below applicable regulatory action limits. The TMI profile of ASOSolv™ ensures that the solvent itself does not limit analytical sensitivity, a critical requirement when working near regulatory thresholds. Spike recoveries in commercially sourced avocado and peanut oils confirm method accuracy across a broad 32-element panel.

For food testing laboratories currently using mineral-based diluents or traditional organometallic standards, ASOSolv™ offers a direct path to lower detection limits, documented blank performance, and improved solvent safety without requiring changes to ICP-OES hardware or sample preparation workflow.

Related Resources:

BENCH BOOST PODCAST

Listen, Learn, and Boost Your Lab Knowledge

Tune in to Bench Boost for practical insights, expert conversations, and real-world solutions covering ICP-OES, ICP-MS, sample preparation, troubleshooting, and more—bringing analytical chemistry topics from the lab bench to life.

[Listen](#)

TECHNICAL WEBINAR

Tips for Trace Analysis by ICP-OES & ICP-MS

Discover practical strategies for improving trace metal analysis by ICP-OES and ICP-MS, from minimizing contamination and selecting the right solution matrices to resolving washout issues and reducing measurement uncertainty for reliable results.

[Watch](#)

WHITE PAPER

A New Method for Testing Wear & Additive Metals in Oils

Explore a validated ICP-OES method for analyzing wear and additive metals in oils using hybrid aqueous/organic standards, enabling the use of aqueous CRMs while simplifying sample preparation and reducing reliance on traditional organic solvents.

[Download](#)

GUIDES & PAPERS

View All Inorganic Ventures Guides & Papers

Explore Inorganic Ventures' library of technical papers, application notes, and educational guides covering ICP analysis, sample preparation, reference materials, quality management, and practical solutions for today's analytical laboratory.

[Explore](#)