Tungsten

HEAVY METAL INDEX · REFERENCE November 2026

Karen Pendergrass · Heavy Metal Index, Institute of Contaminant Standards

CITE AS

Pendergrass, K. (2026). Tungsten. Heavy Metal Index. https://heavymetalindex.com/metals/tungsten

CORRESPONDENCE

Corrections are logged publicly on the article page, each with its date, the affected value, and the source that resolved it.

KEYWORDS

heavy metals, food safety, dietary exposure

PUBLICATION HISTORY

This revision 2026-11-03.

Abstract

This page draws on evidence from EFSA, together with 7 peer-reviewed studies. The complete citation list is at the bottom of the page.

1 | Overview

Tungsten is a transition metal in the same periodic group as chromium and molybdenum, and in soils and waters it occurs mainly as the oxyanion tungstate 2. Its chemistry closely tracks molybdenum, with equal atomic and ionic radii, which is why it can displace molybdenum in enzymes 2. Economically important tungsten minerals include wolframite and scheelite 2.

Food-relevant measurements in the cited evidence come from tungsten mining districts in southern China, where farm soils and rice have been sampled 3 4. Tungsten also appears in food contact materials, and a European food safety opinion assessed a tungsten oxide additive used in food contact plastic 1. A separate line of microbiology research shows that some human gut bacteria take up tungsten and incorporate it into enzymes 5 6.

2 | Toxicology

Mammalian and human evidence

The cited evidence contains no human study and no repeated-dose mammalian study of dietary tungsten. For a tungsten oxide additive, a European food safety panel reviewed two in vitro genotoxicity tests: a bacterial reverse mutation test was negative up to 5,000 micrograms per plate, and a micronucleus test in human lymphocytes was negative up to the limits of solubility and cytotoxicity 1. The panel concluded the substance does not raise a genotoxicity concern, and it noted an oral derived no-effect level of 0.6 mg/kg body weight per day that the European Chemicals Agency had assigned to tungsten oxide 1.

Health concerns are otherwise described only as background in the cited papers. One geochemistry study summarizes earlier reports that high urinary tungsten has been associated with stroke or cardiovascular disease and that animal experiments showed toxicity and carcinogenicity, while noting that any link with childhood

leukemia near a Nevada tungsten area remains unclear 7. These are the authors' summaries of other work and were not tested in the cited studies.

Plant toxicity

In a greenhouse study, soybean on limed soils spiked with 5,000 mg/kg metallic tungsten died after about three weeks, at tissue tungsten of at least 211 mg/kg in shoots and 747 mg/kg in roots 2. Plants on limed sand spiked with 500 mg/kg grew normally at 135 mg/kg in shoots and 398 mg/kg in roots, so the margin between no visible effect and death was narrow 2. Tungsten lowered leaf nitrate reductase, a molybdenum enzyme, and polymeric tungsten species in acidic, heavily spiked soils were linked to poorer growth and nutrient uptake despite lower tungsten uptake 2.

3 | Typical exposure routes

At the Dayu mining district in Jiangxi, the authors of a soil and rice survey estimated that people eating the most contaminated rice could take in up to 0.23 mg of tungsten per day, assuming 0.4 kg of rice per day, compared with 0.002 mg per day from swallowing soil at 50 mg of soil per day 3. They concluded that diet is the main route at contaminated sites and noted that local farmers irrigate with river water draining the mining area 3.

Geothermal water is a second route of environmental release. Hot springs in the Rehai field of Yunnan carried 0.10 to 76.98 micrograms of tungsten per liter, and the authors note that rivers receiving hot spring water serve as local drinking water sources 7. Tungsten in that drinking water was not measured.

Food contact materials are a third route. Migration from plastic containing tungsten oxide at double the maximum intended use level was about 1 microgram of tungsten per kg of simulant 1.

4 | Food sources

Rice is the only food with measured tungsten in the cited evidence. Husked rice grain from 15 paddies next to the Dayu tungsten mines contained 0.02 to 0.57 mg/kg dry weight, far less than the roots, leaves and stems of the same plants 3. Grain-to-soil enrichment factors were only 0.005 to 0.020 3. A later survey in the same county sampled 26 rice grain samples but did not report tungsten in rice 4.

STUDY / LOCATION	MATERIAL / DESIGN	METAL SPECIES	VALUE (UNITS AND BASIS)	N	INTERPRETATION / LIMITATION
2 Dayu county, Jiangxi, China	Husked rice grain, paddies next to tungsten mines	Total W	0.02 to 0.57 mg/kg dry weight; mean 0.17, median 0.09	15	Single season; no detection limit reported
2 Dayu county, Jiangxi, China	Rice root, stem and leaf, same plants	Total W	Means 7.06 (root), 2.34 (stem), 4.76 (leaf) mg/kg dry weight	15	Non-edible tissues; show root and leaf retention
2 Dayu county, Jiangxi, China	Root-zone paddy soil	Total W	3.99 to 43.65 mg/kg; mean 16.57	15	89% to 97% in the residual fraction

3 Dayu county, Jiangxi, China	Agricultural topsoil, six sites	Total W	Mean 19.3 times the 4.93 mg/kg provincial background; 97.2% of samples above background	72	Absolute values only in a supplement
7 Rehai, Yunnan, China	Hot spring and outflow water	Dissolved W	0.10 to 76.98 µg/L	16	Geothermal water, not drinking water
7 Rehai, Yunnan, China	Acidic spring vent sediment	Total W	991 µg/g	1	Extreme case; full sediment data in a supplement
1 Austrian soils, greenhouse	Soybean shoots, limed sand spiked with 500 mg/kg metallic W	Total W	135 mg/kg (mean, SE 10)	4 pots	Spiked experiment; vegetative tissue, not beans
4 EU assessment	95% ethanol simulant from plastic with 150 mg/kg tungsten oxide	W migration	About 1 µg/kg simulant	not stated	Applicant data; simulant, not food

5 | Regulatory limits

The cited evidence establishes no maximum level for tungsten in any food. For food contact plastics, the European food safety panel found tungsten oxide not of safety concern as a reheat additive in polyethylene terephthalate at up to 75 mg/kg, and stated that for other technical functions or other polymers, migration should not exceed 50 micrograms per kg of food, expressed as tungsten 1.

The authors of the Dayu rice survey cite a workplace air limit of 5 mg/m3 in the USA and a former USSR drinking-water limit of 0.05 mg/L, and state that no threshold for tungsten in plants had been set from a food safety viewpoint 3. The later Dayu soil survey used a Dutch soil screening value of 3 mg/kg for tungsten because the Chinese agricultural soil screening values it cites do not include tungsten 4.

6 | Testing

All occurrence studies in the cited evidence measured tungsten by ICP-MS. Soils were digested with mixtures including hydrofluoric acid, and plant tissues with nitric acid and hydrogen peroxide 3 4. One survey reported a tungsten relative error of -0.55% on a certified lateritic soil reference material 4. The European migration test also measured tungsten by ICP-MS 1.

Sample handling matters for water. In the hot spring study, the tungsten split was filtered but left unacidified to avoid precipitation of tungsten oxide under acidic conditions 7. Speciation work used ultrafiltration size classes to separate monomeric from polymeric tungsten in soil solution 2, and ultraviolet-visible peaks near 275 and 320 nm to track polytungstate formation 7. Sequential extraction was used to split soil tungsten into operational fractions 3.

7 | Microbiome effects

The cited evidence shows that some human gut bacteria use tungsten as a nutrient, but it does not show any effect of dietary tungsten on the gut community or on human health. Brevibacillus massiliensis, an aerobic bacterium isolated from human feces, raised its internal tungsten roughly 16-fold when tungstate was added at 100 nM and built it into an enzyme that oxidizes aldehydes found in the gut and in cooked foods 5. That enzyme converted furfural to furoic acid only when tungsten was supplied 5.

Eubacterium limosum, a gut bacterium that makes short-chain fatty acids from lactate with tungsten enzymes, stores tungstate in a small protein that binds about eight tungstate ions per hexamer 6. The authors cite earlier work placing tungstate in the human gut well below 100 nM and predict that similar tungstate-binding proteins are widespread in gut microbes 6. Outside the gut, a hot spring archaeon required about 20 nM tungstate to keep growing in culture 8.

8 | Vulnerable populations

The cited evidence identifies residents of the Dayu mining district, for whom rice is the staple cereal, as the group with the highest estimated dietary tungsten intake 3. The cited studies do not establish differences in susceptibility by age, pregnancy, kidney function or other traits.

9 | Mitigation

The cited evidence does not establish any processing or cooking method that removes tungsten from food. Soil chemistry points to one agronomic caution: liming acidic soil, a common farming practice, raised soybean shoot tungsten 18 to 24 times at a 500 mg/kg spike because it increased soluble monomeric tungsten 2. In the acidic Dayu paddies, most soil tungsten sat in the residual fraction, which the authors read as low mobility and bioavailability 3.

In geothermal settings, iron-rich, goethite-dominated sediments at acidic spring vents trapped polytungstates strongly, and the authors suggest that the absence of such sediments lets tungsten travel downstream 7. Industrial papers in the source list address ore leaching and catalyst recycling, not food mitigation.

10 | Open questions

- No cited study reports tungsten in foods other than rice, in market or retail samples, or outside mining-affected areas.
- The cited evidence does not establish a health-based guidance value for oral tungsten; the only reference value is a derived no-effect level for tungsten oxide noted secondhand.
- Tungsten in drinking water was not measured, even where geothermal rivers supply local water.
- Toxicology in people and in repeated-dose animal studies is not covered by the cited evidence.

- Vulnerable groups beyond residents of mining districts are not addressed.
- Whether processing, washing or milling of rice reduces tungsten is unknown from this evidence.
- Whether dietary tungsten intake changes the activity of tungsten-using gut bacteria has not been tested.
- Absolute soil tungsten values from the later Dayu survey sit in a supplement not reviewed here.

11 | What remains uncertain

The food evidence rests on one field survey of 15 paddies near a single mining district. It shows that rice grain carries far less tungsten than the rest of the plant, but it reports no detection limit for plant tissue and contains an internal inconsistency about whether tissue tungsten tracked soil tungsten. The intake figure is a screening estimate from one assumed rice intake, and no health threshold exists in the cited evidence to judge it against.

Mechanistic work is stronger than exposure work. Soil pH, speciation and sorption to iron minerals clearly govern tungsten mobility, and gut and environmental microbes clearly use tungsten in enzymes. How those findings translate into dietary exposure or human effects remains open.

References

[1] Safety assessment of the substance 'Tungsten Oxide' for use in food contact materials
EFSA CEF Panel, Silano V, Bolognesi C, Cravedi J-P, Engel K-H, Fowler P, et al. · EFSA Journal 15(1): 4661 · 2017 · doi.org/10.2903/j.efsa.2017.4661
GOVERNMENT

[2] pH-Dependent Bioavailability, Speciation, and Phytotoxicity of Tungsten (W) in Soil Affect Growth and Molybdoenzyme Activity of Nodulated Soybeans
Oburger E, Vergara Cid C, Preiner J, Hu J, Hann S, Wanek W, et al. · Environmental Science & Technology 52: 6146-6156 · 2018 · doi.org/10.1021/acs.est.7b06500
PEER-REVIEWED

[3] Tungsten Distribution in Soil and Rice in the Vicinity of the World's Largest and Longest-Operating Tungsten Mine in China
Lin C, Li R, Cheng H, Wang J, and Shao X · PLoS ONE 9(3): e91981 · 2014 · doi.org/10.1371/journal.pone.0091981
PEER-REVIEWED

[4] Health and ecological risk of heavy metals in agricultural soils related to Tungsten mining in Southern Jiangxi Province, China
Lai J, Ni Y, Xu J, and Wu D · PeerJ 12: e17200 · 2024 · doi.org/10.7717/peerj.17200
PEER-REVIEWED

[5] Obligately aerobic human gut microbe expresses an oxygen resistant tungsten-containing oxidoreductase for detoxifying gut aldehydes
Thorgersen MP, Schut GJ, Poole FL II, Haja DK, Putumbaka S, Mycroft HI, et al. · Frontiers in Microbiology 13: 965625 · 2022 · doi.org/10.3389/fmicb.2022.965625
PEER-REVIEWED

[6] Storage of the vital metal tungsten in a dominant SCFA-producing human gut microbe Eubacterium limosum and implications for other gut microbes
Shao N, Zhou D, Schut GJ, Poole FL, Coffey SB, Donaghy AP, et al. · mBio 16(4): e02605-24 · 2025 · doi.org/10.1128/mbio.02605-24
PEER-REVIEWED

[7] Tungsten Accumulation in Hot Spring Sediments Resulting from Preferred Sorption of Aqueous Polytungstates to Goethite
Zhao Q, Guo Q, Luo L, and Yan K · International Journal of Environmental Research and Public Health 18(23): 12629 · 2021 · doi.org/10.3390/ijerph182312629
PEER-REVIEWED

[8] An essential role for tungsten in the ecology and evolution of a previously uncultivated lineage of anaerobic, thermophilic Archaea
Buessecker S, Palmer M, Lai D, Dimapilis J, Mayali X, Mosier D, et al. · Nature Communications 13: 3773 · 2022 · doi.org/10.1038/s41467-022-31452-8
PEER-REVIEWED

STATUS AND LICENCE

Editorially reviewed in-house; no external peer review has been completed on this reference. Published as an institutional technical report with its review state tracked on the article page. Released under CC BY 4.0.

COMPETING INTERESTS

The Heavy Metal Index reports what the peer-reviewed and regulatory literature supports. It is operated separately from any certification program, does not evaluate or endorse brands, and does not use certification thresholds as evidence for the statements made here.

DATA AVAILABILITY

Every source behind this reference is listed with its own source record at https://heavymetalindex.com/metals/tungsten#sources.

PUBLICATION HISTORY

This revision 2026-11-03. The full dated record is maintained at https://heavymetalindex.com/metals/tungsten.