Spices

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HEAVY METAL INDEX · INGREDIENT PROFILE October 2026
DOI 10.83376/hmi.ingredient.spices

CITE AS

Pendergrass, K. (2026). Spices. Heavy Metal Index. https://doi.org/10.83376/hmi.ingredient.spices

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 2026-10-22.

Abstract

Spices in the HMI library has 1,198 reported results for lead, cadmium, total arsenic, inorganic arsenic, dimethylarsinic acid, total mercury, nickel, chromium, aluminum, tin, antimony, Co, Cu, Fe, Mn, Zn, V, Se, As, Be and Sr from 38 sources. WHO gems/food submissions reported lead in spices as sold from 5,229 results in 5 reporting regions, with subgroup medians from 0.725 to 14,500 µg/kg. For cadmium, GEMS/Food gave subgroup medians from 0.085 to 365 µg/kg from 2,684 results.

1 | Spices overview

Across 6 other studies of ordinary farms and markets, reported lead means and medians on an as-sold or fresh-weight basis ranged from 40 µg/kg (Lidiková et al. 2021) to 5,270,000 µg/kg (Ericson et al. 2020).[3,6] For cadmium, 4 studies on an as-sold or fresh-weight basis reported means and medians from 5 µg/kg (Lidiková et al. 2021) to 80 µg/kg (Lidiková et al. 2021).[6] Higher results came from contaminated or exposed settings rather than ordinary supply. Spices as sold from grown independently had total mercury higher at 8.7 µg/kg, against 6.17 µg/kg for all samples in the same study.[7]

For a buyer the practical points are the form bought, the basis a result is reported on, where the spices came from and the laboratory's reporting limit. Testing finds contamination but does not remove it.

2 | What counts as spices

This page covers spices in 5 forms kept separate in every comparison: spices as sold (1,152 results), spices powder or ground (21 results), dried spices (19 results), spices flour or meal (4 results) cooked and spices (2 results).[1,2,3,4,5,6] Foods made from spices that have their own pages, such as herbs and spices, are covered there.

Results stay on the basis each source reports: as sold or fresh weight, dry weight, or unstated. Dry-weight, as-sold and unstated results are never pooled, and no moisture conversion is applied.

3 | How metals reach spices

The evidence on how metals reach spices comes from studies that compared exposed and ordinary settings. Spices as sold from grown independently had total mercury higher at 8.7 µg/kg, against 6.17 µg/kg for all samples in the same study.[7]

These are observational comparisons from single studies; the size of the difference depends on the site, metal and distance.

4 | Which forms and regions measured lower

The hmi reference for lead in spices as sold pools 305 subgroup units from 8 sampling families, with a median of between 44 and 182 µg/kg and a middle half spanning below 44 (lower quartile) and between 187 and 4,140 µg/kg (upper quartile).[1,2,3,5,6,15,16,17] for lead in spices as sold, the reference median was 590 µg/kg, with a middle half from 77 to 6,600 µg/kg across 129 units.[1,6,14] for lead in spices as sold, the reference median was 122 µg/kg, with a middle half from 90 to 290 µg/kg across 14 units.[1]

Among GEMS/Food reporting regions, spices as sold had the lowest lead subgroup median in PAHO (0.725 µg/kg) and the highest in SEARO (6,000 µg/kg); reporting regions are markets, not growing areas.[1] For cadmium, the lowest regional median was in PAHO (0.085 µg/kg) and the highest in EMRO (365 µg/kg).[1] For total arsenic, the lowest regional median was in EURO (50 µg/kg) and the highest in EURO (200 µg/kg).[1]

Targeted spices as sold samples in EURO had lead lower at 49 µg/kg, against 90 µg/kg for EURO in the same study.[1] In another study, targeted spices as sold samples in EURO had lead higher at 230 µg/kg, against 90 µg/kg for EURO in the same study.[1]

In one study, lead across 68 groups of spices ranged from 0.725 µg/kg (PAHO) to 6,000 µg/kg (SEARO); the lowest is the lowest observed in that study, not an established sourcing preference.[1] In another study, lead across 14 groups of spices ranged from 40 µg/kg (cultivar Chupetinho, Imel field plot) to 2,190 µg/kg (cultivar Bhut Jolokia White, Imel field plot); the lowest is the lowest observed in that study, not an established sourcing preference.[6]

5 | Processing, cooking and preparation

Processed or prepared forms were compared only with unprocessed spices in the same study and group. Dried spices (EMRO) had lead lower at 23 µg/kg, against 120 µg/kg for the unprocessed form in the same group (spices as sold).[1] In another study, spices flour or meal (ingredient for canned meatballs in tomato sauce) had cadmium lower at 10 µg/kg, against 70 µg/kg for the unprocessed form in the same group (spices as sold).[16]

Forms differ in water content, so a per-kilogram difference is not by itself a measured removal or gain of metal.

6 | Mitigation for spices

Lot testing against the applicable limit is the check that can be verified.

7 | Trade-offs and limits of controls

Avoiding exposed growing areas lowered the metal measured in the studies available, but no study measured the cost or supply effect of doing so.[7] Metals do not move together, so a lot that passes a lead limit says little about cadmium, arsenic or nickel unless those are tested as well.

8 | Testing spices for metals

Results depend on the method and its reporting limit. Reporting limits for lead ranged from 0.01 µg/kg (Lidiková et al. 2021) to 5,000 µg/kg (WHO GEMS/Food), so a non-detect from a less sensitive method says much less.[1,6] Reporting limits for cadmium ranged from 0.2 µg/kg (Winiarska-Mieczan et al. 2023) to 1,000 µg/kg (WHO GEMS/Food), so a non-detect from a less sensitive method says much less.[1,17] Reporting limits for total arsenic ranged from 9 µg/kg (WHO GEMS/Food) to 2,000 µg/kg (WHO GEMS/Food), so a non-detect from a less sensitive method says much less.[1]

A useful lot result names the form, the basis and a quantification limit well below the limit that applies.

9 | Buying and verifying spices

No maximum level for metals in spices was verified from primary text for this page; buyers should confirm the limit that applies in the destination market.

10 | Exposure from spices

No source in the library converted spices concentrations into a verified estimate of intake for a defined population. Concentrations describe the food, not individual risk.

11 | Evidence review and remaining gaps

Every source record that names spices was decided on its content: 38 occurrence extracted, 38 records in all. The occurrence table renders every extracted result; held values remain visible with their reason.

References identify the sources used in these answers. The Sources index preserves additional discovery links; inclusion there does not mean a source has been reviewed for this assessment. Corrections, completed searches, new direct evidence and changes in requirements should reopen the relevant answer.

12 | Spices FAQs

The library reports lead, cadmium, total arsenic, inorganic arsenic, dimethylarsinic acid, total mercury, nickel, chromium, aluminum, tin, antimony, Co, Cu, Fe, Mn, Zn, V, Se, As, Be and Sr in spices, most often lead, cadmium and total arsenic.[1,2,3,4] WHO gems/food submissions reported lead in spices as sold from 5,229 results in 5 reporting regions, with subgroup medians from 0.725 to 14,500 µg/kg.[1]

In the studies available, spices from contaminated or exposed settings carried more metal than spices from the same study's control.[7] spices as sold from grown independently had total mercury higher at 8.7 µg/kg, against 6.17 µg/kg for all samples in the same study.[7]

Among GEMS/Food reporting regions, spices as sold had the lowest lead subgroup median in PAHO (0.725 µg/kg) and the highest in SEARO (6,000 µg/kg); reporting regions are markets, not growing areas.[1] For cadmium, the lowest regional median was in PAHO (0.085 µg/kg) and the highest in EMRO (365 µg/kg).[1]

Only comparisons between forms in the same study are available, not before-and-after measurements of the same spices.[1] dried spices (EMRO) had lead lower at 23 µg/kg, against 120 µg/kg for the unprocessed form in the same group (spices as sold).[1]

Inorganic arsenic, the more toxic form, was measured in 15 results from 2 sources, far fewer than total arsenic.[1,18] European Food Safety Authority (EFSA) 2014 reported inorganic arsenic at 69.9 µg/kg (mean) in spices as sold from European dietary-survey occurrence data.[18]

References

[1] GEMS/Food Contaminants database heavy-metal exports
World Health Organization · GEMS/Food Contamination Monitoring and Assessment Programme · 2026 · extranet.who.int
DATASET

[2] Lead in Spices, Herbal Remedies, and Ceremonial Powders Sampled from Home Investigations for Children with Elevated Blood Lead Levels — North Carolina, 2011–2018
Angelon-Gaetz KA, Klaus C, Chaudhry EA, and Bean DK · MMWR Morbidity and Mortality Weekly Report · 2018 · doi.org/10.15585/mmwr.mm6746a2
GOVERNMENT

[3] Elevated Levels of Lead (Pb) Identified in Georgian Spices
Ericson B, Gabelaia L, Keith J, Kashibadze T, Beraia N, Sturua L, et al. · Annals of Global Health · 2020 · doi.org/10.5334/aogh.3044
PEER-REVIEWED

[4] Results of the BfR MEAL Study: In Germany, mercury is mostly contained in fish and seafood while cadmium, lead, and nickel are present in a broad spectrum of foods
Fechner C, Hackethal C, Höpfner T, Dietrich J, Bloch D, Lindtner O, et al. · Food Chemistry: X · 2022 · doi.org/10.1016/j.fochx.2022.100326
PEER-REVIEWED

[5] Heavy metals in spices from Lancaster, PA: arsenic, cadmium, and lead exposure risks and the need for regulation
Huff A, Lam H, Ghimirey A, Goldring J, Pimentel M, and Okatch H · Environmental Monitoring and Assessment · 2025 · doi.org/10.1007/s10661-025-14064-9
PEER-REVIEWED

[6] Heavy Metals Presence in the Soil and Their Content in Selected Varieties of Chili Peppers in Slovakia
Lidiková J, Čeryová N, Šnirc M, Musilová J, Harangozo Ľ, Vollmannová A, et al. · Foods 2021, 10(8), 1738 · 2021 · doi.org/10.3390/foods10081738
PEER-REVIEWED

[7] The Mercury Concentration in Spice Plants
Fischer A and Brodziak-Dopierała B · Processes · 2022 · doi.org/10.3390/pr10101954
PEER-REVIEWED

[8] Assessment of toxic trace metal contamination in food spices sold in Nigerian markets
Chime CI, Eze M, Ndukwe IE, Abah EI, Chinyere OND-R, and Anene CS · World Journal of Advanced Research and Reviews · 2025 · doi.org/10.30574/wjarr.2025.27.2.3032
PEER-REVIEWED

[9] Assessment of the Level of Heavy Metals in Irrigation Water, Farm Soil, and Vegetables Grown in Gobbiya Dam, Bogoro Local Government Area Bauchi State, Nigeria
John Joseph, Toma Buba, Jalo Enoch, and Ayuba Kaluri · Journal of Energy Technology and Environment 7(4):79–92 · 2025 · doi.org/10.37933/jete/7.4.2025.2568
PEER-REVIEWED

[10] Heavy metal content in mixed and unmixed seasonings on the Ghanaian market
Darko B, Ayim I, and Voegborlo RB · African Journal of Food Science · 2014 · doi.org/10.5897/AJFS2013.1107
PEER-REVIEWED

[11] Pollution of four heavy metal elements in dried chili peppers in Guizhou Province and its health risk assessment
Zhou LQ and Liu WZ · Scientific Reports 2024, 14: 17759 · 2024 · doi.org/10.1038/s41598-024-68564-8
PEER-REVIEWED

[12] Mineral and Microbiological Analysis of Spices and Aromatic Herbs
Cicero N, Gervasi T, Durazzo A, Lucarini M, Macrì A, Nava V, et al. · Foods · 2022 · doi.org/10.3390/foods11040548
PEER-REVIEWED

[13] Genotoxic studies of cooked and uncooked processed spices using Allium cepa Test
Adams FM, Njoku K, Famotemi AC, Idowu D, and Tijani AA · International Journal of Advanced Research in Biological Sciences · 2017 · doi.org/10.22192/ijarbs.2017.04.09.004
PEER-REVIEWED

[14] Evaluation of Effects of Heavy Metal Contents of Some Common Spices Available in Odo-Ori Market, Iwo, Nigeria
Peter Olusakin Oladoye and David Olaoluwa Jegede · Journal of Environmental Analytical Chemistry · 2016 · doi.org/10.4172/2380-2391.1000174
PEER-REVIEWED

[15] Rapid Market Screening to assess lead concentrations in consumer products across 25 low- and middle-income countries
Sargsyan A, Nash E, Binkhorst G, Forsyth JE, Jones B, Sanchez Ibarra G, et al. · Scientific Reports · 2024 · doi.org/10.1038/s41598-024-59519-0
PEER-REVIEWED

[16] Determination of toxic elements in meat products from Serbia packaged in tinplate cans
Stojanović B, Janković S, Đorđević V, Marjanović S, Vasilev D, Stojanović Z, et al. · Research Square preprint, posted 26 February 2021 (version 1) · 2021 · doi.org/10.21203/rs.3.rs-271859/v1
PREPRINT

[17] The Content of Cd and Pb in Herbs and Single-Component Spices Used in Polish Cuisine
Winiarska-Mieczan A, Jachimowicz K, Kwiecień M, Krusiński R, Kislova S, Sowińska L, et al. · Biological Trace Element Research · 2023 · doi.org/10.1007/s12011-022-03437-7
PEER-REVIEWED

[18] Dietary exposure to inorganic arsenic in the European population
European Food Safety Authority (EFSA) · EFSA Journal 2014;12(3):3597 · 2014 · doi.org/10.2903/j.efsa.2014.3597
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STATUS AND LICENCE

Editorially reviewed in-house; no external peer review has been completed on this ingredient profile. 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 ingredient profile is listed with its own source record at https://heavymetalindex.com/ingredients/spices#sources.

PUBLICATION HISTORY

This revision 2026-10-22. The full dated record is maintained at https://heavymetalindex.com/ingredients/spices.