Cinnamon

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Abstract

Lead is the metal that decides most cinnamon questions. In 808 WHO GEMS/Food lead results for cinnamon bark from 2003 to 2024, the median was about 350 µg/kg and 103 results (13%) were above 2,000 µg/kg, the EU maximum for bark spices. Codex set a 2,500 µg/kg lead limit for dried bark spices in 2025, and China allows 3,000 µg/kg for cassia bark.

1 | Cinnamon overview

Retail surveys show the same wide spread. Ten powdered products bought in Queensland ranged from 150 to 7,000 µg/kg lead, 37 bulk samples from Casablanca averaged 2,050 µg/kg, and five cassia samples from Iraq averaged 4,159 µg/kg, while single samples from Indonesia and Serbia held 23 and 310 µg/kg.[4,5,9,10,11] Cadmium is usually a few hundred µg/kg, and chromium, nickel and aluminum are high enough in some products to matter alongside lead.[1,4,9]

A separate problem is deliberate adulteration. In 2023 cinnamon ground in Ecuador and contaminated with lead chromate reached the United States in apple cinnamon pouches that held 1,900-5,800 µg/kg lead as sold, and 566 cases of elevated blood lead were reported in 44 states, the District of Columbia and Puerto Rico.[3,12] Those results are kept apart from the ordinary occurrence data on this page. For a buyer, the supported priority is a lot-specific result for lead and chromium together, with species and form recorded; a species label or an origin alone does not settle it.[1,3,6]

2 | What counts as cinnamon

This page covers dried cinnamon bark, sold ground or as sticks and pieces, from any Cinnamomum species.[1,4] Cassia (C. Cassia and related species, including Saigon and Indonesian cinnamon) and Ceylon cinnamon (C. Verum, also called C. Zeylanicum or true cinnamon) are labeled separately wherever a source names the species, and cinnamon of unstated species stays its own group.[1,4,5,13]

Species labels are rarely verified. An Australian survey labeled all ten products C. Verum although two came from China and two from Vietnam, where cassia is the usual crop, and no study in the ledger authenticated the species analytically.[4] cinnamon flowers, cinnamon sugar, blended teas, cinnamon-flavoured cereals and bakery, infant foods that list cinnamon, and purging cassia (Cassia fistula, a different plant) are outside this scope.[1,14]

Place names need the same care. A WHO GEMS/Food region is the region that reported the result, not where the bark grew, and most surveys report where the product was bought.[1,9,13] Finished applesauce from the 2023 outbreak is a different material: its lead was measured in the puree, not in the cinnamon.[12]

3 | How metals reach cinnamon

Cinnamon carries metals from two very different routes. The ordinary route is the bark and what settles on it: nearly every product carries measurable lead, cadmium, nickel, chromium and aluminum, consistent with uptake from soil and with dust.[1,4,5] In Iraq, unwashed spices held on average 7% more lead and 14% more cadmium than the same spices washed, a sign that part of the burden sits on the surface.[5]

The second route is adulteration. The United States Food and Drug Administration traced the 2023 applesauce lead to cinnamon ground in Ecuador and reported that the lead and chromium came from lead chromate, a yellow pigment.[3,12] Lead chromate raises lead and chromium together, so the two are screened as a pair; a Western Australian survey of 380 products found no evidence of high lead chromate in the samples it screened.[3,6]

Equipment and grinding are plausible third routes. Australian authors suggest that aluminum utensils and stainless-steel equipment may add aluminum, chromium and nickel; the Vietnamese product with 7,000 µg/kg lead also carried 920,000 µg/kg aluminum, 4,000 µg/kg chromium and 2,000 µg/kg nickel.[4] No study in the ledger measured cinnamon before and after grinding.

4 | Which cinnamon types and origins measured lower

For lead, cinnamon labeled as Ceylon (C. Verum) measured lower than cinnamon labeled as cassia in the largest dataset.[1] In WHO GEMS/Food, 58 lead results labeled C. Verum had a median of 225 µg/kg, with 2 (3%) above 2,000 µg/kg, against a median of 392 µg/kg and 60 of 268 (22%) above 2,000 µg/kg for results labeled cassia.[1] Most cassia results came from one Western Pacific reporting region, so species and source cannot be separated, and the labels were not verified.[1]

Within single studies, the C. Verum label did not guarantee low lead.[4,13] Queensland products labeled C. Verum ranged from 150 µg/kg (China) and 160 µg/kg (Vietnam) to 2,400 µg/kg (Sri Lanka), 2,500 µg/kg (India) and 7,000 µg/kg (Vietnam).[4] Three C. Verum samples on the Italian market measured 294 µg/kg (Madagascar) and 766 µg/kg (Indonesia), while the Vietnamese sample was higher but its printed mean conflicts with its own replicate range.[13] These are lowest observed values from one to two samples per country, not a ranking of countries.

Form mattered more consistently for lead. Sticks and pieces in GEMS/Food had a median of 90 µg/kg and none of 46 results above 2,000 µg/kg, against a median of 560 µg/kg and 20 of 234 above it for ground cinnamon.[1] Western Australia found that most lead results above 2,000 µg/kg were ground cinnamon.[6] This is a tentative pattern: the sticks came from fewer regions and years.[1]

Cadmium follows species and origin less clearly. GEMS/Food cadmium had a median of about 220 µg/kg with no result above 1,000 µg/kg, and C. Verum-labeled results were somewhat lower (median 150 against 230 µg/kg).[1] One Sri Lankan product in Queensland reached 3,700 µg/kg while the other held 150 µg/kg, and five Iraqi cassia samples averaged 874 µg/kg.[4,5]

Choosing sticks for lead can raise chromium. In the one GEMS/Food submission that measured chromium, five stick samples had a median of 760 µg/kg against 215 µg/kg for ten ground samples.[1] Arsenic and mercury are low enough in most cinnamon that their comparisons rarely change a decision: GEMS/Food total mercury never exceeded 50 µg/kg and inorganic arsenic was 27 µg/kg at most.[1]

In the monitoring data, yes on average: GEMS/Food results labeled C. Verum had a median of 225 µg/kg lead against 392 µg/kg for cassia-labeled results, and far fewer exceeded 2,000 µg/kg (3% against 22%).[1] But the labels were not verified, most cassia results came from one reporting region, and Australian products labeled C. Verum ranged up to 7,000 µg/kg.[1,4]

For lead, yes in the monitoring data: sticks had a median of 90 µg/kg and none of 46 results above 2,000 µg/kg, against 560 µg/kg for ground cinnamon.[1] For chromium, the one submission measuring both forms found sticks higher (median 760 against 215 µg/kg).[1]

5 | Washing, processing and finished foods

Processing evidence for cinnamon is thin. Across 23 Iraqi spices, unwashed portions held on average 7% more lead, 14% more cadmium and 11% more mercury than portions washed with tap and deionised water; cinnamon was not reported separately and the unwashed values were not printed.[5] No study measured roasting, sterilisation or extraction.

Finished foods carry the cinnamon's metals into much larger servings. A baby-food manufacturer accepted nine cinnamon lots with 20-887 µg/kg lead and 117-345 µg/kg cadmium under an internal specification of 1,000 µg/kg, and another recalculated one lot to the finished food as consumed.[14] In the outbreak, the adulterated cinnamon raised lead in the whole puree to 1,900-3,000 µg/kg in pouches from affected homes.[12]

6 | Mitigation from sourcing to recall

Controls for cinnamon act at sourcing, at lot acceptance and at recall. The measured comparisons are observational: lower lead in sticks than in ground cinnamon and in C. Verum-labeled than in cassia-labeled results, and higher lead exceedance in bulk than in packaged spices in Lebanon.[1,15] Testing for lead and chromium together detects lead chromate before release, and recall audits found recalled pouches still on 5 of 217 store shelves weeks later.[3,6,12]

7 | Trade-offs and limits of controls

Every sourcing lever has a cost. Sticks were lower in lead but higher in chromium in the one submission that measured both, and the C. Verum label did not prevent 2,400-7,000 µg/kg lead in Australian products.[1,4] A

specification set high enough to pass every lot, such as 1,000 µg/kg for lead in infant-food cinnamon, accepts lots that a lower limit would reject.[14]

Screening for the adulterant has limits too. A lead result alone does not show whether lead chromate is present; Western Australia used co-elevated lead and chromium as its screen, while FDA confirmed lead chromate only with an additional analysis.[3,6]

8 | Testing cinnamon for metals

A useful cinnamon test measures lead, chromium and cadmium, with quantification limits well below 2,000 µg/kg for lead.[2,7] Most GEMS/Food lead results carried detection limits of 3-30 µg/kg, but 75 used 100 µg/kg, and arsenic and tin results often used limits of 100-500 µg/kg, too high to describe typical cinnamon.[1] Several surveys printed values only in figures or named no statistic, and Western Australian and Lebanese reports gave counts of samples above thresholds that conflict with their own figures or tables.[6,15,18,19]

Record species, form, labeled origin and purchase market with every result, and report non-detects with their limit.[1,4] Chromium results are total chromium; lead chromate contains hexavalent chromium, but no source in the ledger measured hexavalent chromium in cinnamon.[3,20]

Some high values are real: GEMS/Food holds lead results up to 23,800 µg/kg and Iraqi cassia averaged 4,159 µg/kg.[1,5] Others do not survive a check against their own papers, such as a Bangladeshi sample whose lead is 10,050 µg/kg in the text and about 15,470 µg/kg in the paper's own figure and tables.[17]

9 | Buying and verifying cinnamon

Ask for lot-specific lead and chromium results with the laboratory's quantification limit, compared with the limit i n the destination market.[2,7,8] Limits differ: the EU allows 2,000 µg/kg lead in bark spices, Codex 2,500 µg/kg, China 3,000 µg/kg for cassia bark, and Vietnam 2,000 µg/kg lead and 1,000 µg/kg cadmium in spices.[2,7,8,21]

Record the species, the form and the growing origin separately from where the cinnamon was packed or bought.[1,4] Whole sticks and C. Verum-labeled lots were lower in lead in the monitoring data, but a label is not a verified species and one survey's C. Verum products reached 7,000 µg/kg.[1,4] Lebanese packers with and without a food safety management system showed the same lead exceedance rate, so a management system alone is not evidence of metal control.[15]

10 | Exposure from cinnamon

Cinnamon is eaten in small amounts, but children eat more per kilogram of body weight.[22,23] In a Southern California survey, people who ate cinnamon averaged 1.34 g a day, and United States dietary data used by New York State put children under seven at 4.1-9.1 mg per kilogram of body weight a day among eaters, against 1.8 mg for adults.[22,23] No source in the ledger estimated what share of a person's lead intake comes from cinnamon.

The outbreak shows what adulterated cinnamon can do in a children's food. Pouches held 1,900-3,000 µg/kg l ead in affected homes, and among 531 confirmed and probable cases the median highest blood lead was 7.2 µ g/dL.[3,12] Two cinnamon samples collected from North Carolina homes of children with elevated blood lead held 2,500-2,700 µg/kg lead.[24]

11 | Evidence review and remaining gaps

This assessment covers every source record in the HMI library that is tagged to cinnamon or mentions it, plus every cinnamon row in the WHO GEMS/Food, FDA and other indexed datasets; each has a recorded decision based on its content. Values from four papers are held because they could not be reconciled with their own methods or tables.[5,13,15,17] Gaps remain: one X-ray fluorescence study's cinnamon result sits in an unretrieved s upplement, and no study authenticated the cinnamon species.[4,25]

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 | Cinnamon FAQs

Lead is the metal most often found at levels that matter, with a GEMS/Food median of about 350 µg/kg and 13% of results above the EU limit of 2,000 µg/kg.[1,2] cinnamon also carries cadmium (GEMS/Food median about 220 µg/kg), chromium, nickel and a great deal of aluminum; arsenic and mercury are usually low.[1,4,9]

Mostly from soil and dust taken up or deposited on the bark, and in some lots from deliberate adulteration with lead chromate.[3,5] The 2023 outbreak cinnamon was contaminated this way after grinding in Ecuador.[3]

No source in the ledger compares organic and conventional cinnamon for metals. Organic-labeled lots tested by a baby-food manufacturer held 20-126 µg/kg lead and 117-225 µg/kg cadmium, so organic cinnamon is not metal-free.[14]

In the monitoring data, whole sticks and cinnamon labeled C. Verum (Ceylon) were lowest, with lead medians of 90 and 225 µg/kg.[1] Neither is a guarantee: Australian products labeled C. Verum reached 7,000 µg/kg, and sticks were higher in chromium.[1,4]

The evidence cannot rank countries. Single samples from Indonesia measured 23 µg/kg lead in one study and 766 µg/kg in another, products from Vietnam and Sri Lanka ranged from 160 to 7,000 µg/kg within one survey, and most datasets record only where cinnamon was bought.[4,10,13]

They can carry the cinnamon's metals: in the 2023 outbreak, apple cinnamon pouches held 1,900-5,800 µg/kg l ead because of adulterated cinnamon.[12] No study in the ledger measured an ordinary cinnamon and the food made with it together.

Cinnamon is eaten in small amounts, about 1.8 mg per kilogram of body weight a day for adult eaters in United States data, but children under seven eat two to five times more per kilogram.[22] No source in the ledger estimated cinnamon's share of lead intake, and adulterated cinnamon caused the 2023 outbreak with 566 reported cases o f elevated blood lead.[3]

Yes, mostly for lead: the EU allows 2.0 mg/kg in bark spices, Codex 2.5 mg/kg, China 3.0 mg/kg for cassia bark and Vietnam 2.0 mg/kg for spices.[2,7,8,21] Vietnam also limits cadmium (1.0 mg/kg) and mercury (0.05 mg/kg) in spices.[21]

Only partly, and not reliably: across 23 spices, unwashed portions held on average 7% more lead and 14% more cadmium than washed portions.[5] No method removes lead chromate from adulterated cinnamon; lots must be tested and rejected.[3,6]

Surveys measure total chromium, and no source in the ledger measured hexavalent chromium in cinnamon.[4,20] Lead chromate contains hexavalent chromium, which is why FDA flagged chromium in the outbreak cinnamon.[3]

For lead, yes in GEMS/Food: sticks had a median of 90 µg/kg against 560 µg/kg for ground cinnamon.[1] For chromium the one paired submission found the opposite.[1]

For lead, C. Verum-labeled cinnamon measured lower on average in monitoring data, but the labels were not verified and individual C. Verum products reached 7,000 µg/kg.[1,4] No source in the ledger compared the two species directly under one method.

Children under seven eat 4.1-9.1 mg of cinnamon per kilogram of body weight a day among eaters in United States data, more than adults.[22] The 2023 outbreak affected mostly young children who ate apple cinnamon pouches.[3,12]

In October 2023 apple cinnamon fruit puree pouches were recalled after North Carolina found 1,900-3,000 µg/kg lead in pouches from affected homes.[12] FDA traced the lead to cinnamon ground in Ecuador and contaminated with lead chromate; the recall grew to 2,998,088 pouches.[3]

Measure lead and chromium in the same lot: lead chromate raises both, and Western Australia used co-elevated lead and chromium as its screen.[6] FDA confirmed lead chromate with an additional analysis after the high lead and chromium results.[3]

Possibly: across 13 spices in Lebanon, 31% of bulk composites exceeded 0.3 mg/kg lead against 12% of locally packaged ones.[15] For cinnamon itself the difference was small: bulk composites averaged 318 µg/kg lead against 269 µg/kg for packaged brands with a food safety system, and 37 bulk Moroccan samples averaged 2,050 µg/kg.[9,15]

Yes, often a lot: Queensland products averaged 308,100 µg/kg aluminum and GEMS/Food results from the Western Pacific had a median of 139,000 µg/kg.[1,4] Aluminum is not limited in spices by the instruments verified here.[2,21]

Not clearly: the share of GEMS/Food results above 2,000 µg/kg was 11% for 2003-2012, 19% for 2013-2017 and 8% for 2018-2024.[1] These are national submissions from changing countries and regions, not a fixed panel of products.

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] Commission Regulation (EU) 2023/915 of 25 April 2023 on maximum levels for certain contaminants in food and repealing Regulation (EC) No 1881/2006
European Commission · Official Journal of the European Union · 2023 · eur-lex.europa.eu
REGULATION

[3] Investigation of Lead and Chromium Exposure After Consumption of Contaminated Cinnamon-Containing Applesauce — United States, November 2023–April 2024
Troeschel AN, Buser MC, Winquist A, Ruckart P, Yeh M, Kuai D, et al. · Morbidity and Mortality Weekly Report (MMWR) · 2025 · doi.org/10.15585/mmwr.mm7414a2
GOVERNMENT

[4] Heavy metal analysis in commercial spices and herbs by inductively coupled plasma mass spectrometry (ICP-MS) and estimated dietary exposure
Tinggi U, Farrell M, Porter J, Mitchell S, and Jurd S · Journal of Environmental Exposure Assessment · 2025 · doi.org/10.20517/jeea.2025.10
PEER-REVIEWED

[5] Using Stripping Voltammetry to Determine Heavy Metals in Cooking Spices Used in Iraq
Matloob MH · Polish Journal of Environmental Studies · 2016 · doi.org/10.15244/pjoes/62401
PEER-REVIEWED

[6] Coordinated Sampling Project 41: Microbial and Heavy Metal Detections in Herbs and Spices
LHAAC · Local Health Authorities Analytical Committee, Edith Cowan University · 2025
GOVERNMENT

[7] General Standard for Contaminants and Toxins in Food and Feed (CXS 193-1995)
Codex Alimentarius Commission · Codex Alimentarius (Joint FAO/WHO Food Standards Programme) · 1995 · www.fao.org
GOVERNMENT

[8] GB 2762-2025: National Food Safety Standard — Maximum Levels of Contaminants in Foods
National Health Commission and State Administration for Market Regulation · National Food Safety Standard of the People's Republic of China · 2025 · www.fzmq.gov.cn
STANDARD

[9] Essential and Toxic Element Profiles in Selected Spices from Greater Casablanca, Morocco
Sabri S, Sabri C, Salam MR, El Mellouli F, Lafram A, Khallouki H, et al. · World's Veterinary Journal 15(4): 863-881 · 2025 · doi.org/10.54203/scil.2025.wvj88
PEER-REVIEWED

[10] 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

[11] Determination of the mineral content of spices by ICP-OES
Savić S, Petrović S, Petronijević M, Cvetanović A, and Petronijević Ž · Advanced Technologies · 2019 · doi.org/10.5937/savteh1901027s
PEER-REVIEWED

[12] Childhood Lead Exposure Linked to Apple Cinnamon Fruit Puree Pouches — North Carolina, June 2023–January 2024
Napier MD and et al. · MMWR Morbidity and Mortality Weekly Report · 2024 · doi.org/10.15585/mmwr.mm7328a2
GOVERNMENT

[13] Heavy metals in aromatic spices by inductively coupled plasma-mass spectrometry
Bua DG, Annuario G, Albergamo A, Cicero N, and Dugo G · Food Additives & Contaminants: Part B · 2016 · doi.org/10.1080/19393210.2016.1175516
PEER-REVIEWED

[14] Baby Foods Are Tainted with Dangerous Levels of Arsenic, Lead, Cadmium, and Mercury
U.S. House of Representatives, Committee on Oversight and Reform, Subcommittee on Economic and Consumer Policy · Staff Report · 2021 · oversight.house.gov
GRAY LITERATURE

[15] Impact of source, packaging and presence of food safety management system on heavy metals levels in spices and herbs
Moussa L, Hassan HF, Savvaidis IN, and Karam L · PLoS ONE · 2024 · doi.org/10.1371/journal.pone.0307884
PEER-REVIEWED

[16] Investigation of Element Migration from Aluminum Cooking Pots Using ICP-MS
Ammar HR, Saleh SM, Sivasankaran S, Albadri AEAE, and Al-Mufadi FA · Applied Sciences (MDPI) · 2023 · doi.org/10.3390/app132413119
PEER-REVIEWED

[17] Heavy Metals Induced Health Risk Assessment Through Consumption of Selected Commercially Available Spices in Noakhali District of Bangladesh
Islam MS, Chowdhury AI, Shill LC, Reza S, and Alam MR · medRxiv (preprint) · 2023 · doi.org/10.1101/2023.02.06.23285555
PREPRINT

[18] 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

[19] Heavy Metal Contamination of Hot Sauce and Chili Powder
SPEX CertiPrep / ZeptoMetrix · SPEX Application Note (ZeptoMetrix) · 2023
INDUSTRY

[20] Scientific Opinion on the risks to public health related to the presence of chromium in food and drinking water
EFSA Panel on Contaminants in the Food Chain (CONTAM) · EFSA Journal 2014;12(3):3595 · 2014 · doi.org/10.2903/j.efsa.2014.3595
GOVERNMENT

[21] QCVN 8-2:2011/BYT National technical regulation on the safety limits of heavy metal contamination in food (English)
Vietnam Ministry of Health · Circular No. 02/2011/TT-BYT, QCVN 8-2:2011/BYT · 2011
REGULATION

[22] Technical Support Document for Derivation of Health-Based Guidance Values for Metals in Spices
Bureau of Toxic Substance Assessment, Center for Environmental Health, and New York State Department of Health · 2019
GOVERNMENT

[23] Assessing Dietary Consumption of Toxicant-Laden Foods and Beverages by Age and Ethnicity in California: Implications for Proposition 65
Masri S, Nasla S, Payán DD, and Wu J · Nutrients · 2025 · doi.org/10.3390/nu17193149
PEER-REVIEWED

[24] 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

[25] instrumentation for monitoring toxic elements in food matrices:
Unknown authors · Peer-reviewed article · 2025 · doi.org/10.1016/j.radphyschem.2025.112749
PEER-REVIEWED

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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.

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