White sugar

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Abstract

White sugar in the HMI library has 404 reported results for lead, cadmium, total arsenic, inorganic arsenic, total mercury, methylmercury, nickel, chromium, aluminum, tin, antimony, uranium, Co, Cu, Fe, Mn, Zn, V, Se, Ba, Ca, K, Mg, Sr and Tl from 29 sources. WHO GEMS/Food submissions reported lead in white sugar as sold from 3,255 results in 5 reporting regions, with subgroup medians from 5.3 to 82 µg/kg. In the US Total Diet Study, white sugar as sold had a median lead result below 4 µg/kg across 3 composites from 2018-2020.

1 | White sugar overview

Across 5 other studies of ordinary farms and markets, reported lead means and medians on an as-sold or fresh-weight basis ranged from 26 µg/kg (Marín et al. 2018) to 6,740 µg/kg (Babeker et al. 2022).[5,8] For cadmium, 2 studies on an as-sold or fresh-weight basis reported means and medians from 217 µg/kg (Bekele 2024) to 620 µg/kg (Babeker et al. 2022).[5,6] Higher results came from contaminated or exposed settings rather than ordinary supply. White sugar as sold from commercial sample S4 had chromium higher at 227 µg/kg, against 4.63 µg/kg for commercial sample S2 in the same study.[7]

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

2 | What counts as white sugar

This page covers white sugar in 2 forms kept separate in every comparison: white sugar as sold (403 results) and white sugar juice (1 result).[1,2,3,4,5,6]

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.

Non-centrifugal cane sugar (NCS), sold under names including rapadura (Brazil), panela (Colombia and Ecuador), and jaggery (South Asia), is a distinct artisanal product made by evaporating clarified sugarcane juice without centrifugation to remove molasses. It retains minerals, organic acids, and inorganic contaminants present in the whole-cane matrix, and its contamination profile cannot be inferred from refined white sugar data. Milani et al. 2025 measured lead, cadmium, and total arsenic in 72 NCS samples purchased from local markets in Brazil, Colombia, Ecuador, Mexico, and Peru using ICP-OES after ultrasound acid digestion: lead was detected and quantified in all 72 samples (range 65 to 122 µg/kg, dry weight as sold), cadmium was detected in 31 percent of samples (up to 45 µg/kg), and total arsenic was below the limit of quantification (LOQ 37 µg/kg) in all samples.[17] Evidence from NCS is treated as context for understanding cane-derived contamination pathways rather than as a direct measure of refined white sugar contamination.

3 | How metals reach white sugar

The evidence on how metals reach white sugar comes from studies that compared exposed and ordinary settings. White sugar as sold from commercial sample S4 had chromium higher at 227 µg/kg, against 4.63 µg/kg for commercial sample S2 in the same study.[7]

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

For cadmium, soil contamination from phosphate-based fertilizers is a recognized pathway in cane cultivation. In a 72-sample Latin American survey, cadmium was detectable in NCS/rapadura at levels up to 45 µg/kg, with higher rates in Peru and Mexico than in Brazil and Ecuador; the authors attributed variability to soil contamination, fertilizer use, and regional processing conditions.[17] A controlled field experiment in Colombia found that sugarcane (Saccharum officinarum) translocates soil cadmium to leaf tissue: at a soil cadmium loading of 50 mg/kg, leaf concentrations reached 1.21 mg/kg dry weight without mycorrhizal inoculation; arbuscular mycorrhizal fungi reduced leaf cadmium to 0.47 mg/kg by retaining metal in roots.[18] The experimental cadmium dose (50 mg/kg soil) is not representative of ordinary agricultural conditions; these results characterize the soil-to-plant pathway mechanism, not expected food concentrations.

4 | Which forms and regions measured lower

The HMI reference for lead in white sugar as sold pools 122 subgroup units from 7 sampling families, with a median of below 20 µg/kg and a middle half spanning below 4 (lower quartile) and between 20 and 100 µg/kg (upper quartile).[1,2,3,7,9,10,11] for cadmium in white sugar as sold, the reference median was below 1 µg/kg, with a middle half from below 0.659 to below 30 µg/kg across 116 units.[1,2,3,7,9,10,11] for total arsenic in white sugar as sold, the reference median was below 12 µg/kg, with a middle half from below 3 to between 13.7 and 47.5 µg/kg across 54 units.[1,2,5,11,12]

Among GEMS/Food reporting regions, white sugar as sold had the lowest lead subgroup median in PAHO (5.3 µg/kg) and the highest in EURO (82 µg/kg); reporting regions are markets, not growing areas.[1] For cadmium, the lowest regional median was in PAHO (0.2 µg/kg) and the highest in EMRO (23 µg/kg).[1]

In one study, lead across 6 groups of white sugar ranged from 54 µg/kg (production batch 2019, Omo Kuraz sugar factory) to 508 µg/kg (production batch 2023, Omo Kuraz sugar factory); the lowest is the lowest observed in that study, not an established sourcing preference.[6]

Non-centrifugal cane sugar from Latin America showed lead concentrations above the refined-sugar reference range across all five countries surveyed: country mean lead values ranged from 74 µg/kg (Colombia, n=36) to 107 µg/kg (Peru, n=5), with all country means falling between 65 and 122 µg/kg dry weight as sold; 33 percent of the 72 samples exceeded the Brazilian and MERCOSUR sugar limit for lead of 100 µg/kg, primarily from Minas Gerais and Rio Grande do Sul in Brazil, Quito and Vilcabamba in Ecuador, Mexico, and La Victoria and Lima in Peru.[17] These are NCS/rapadura values, not refined white sugar values, and are reported here as a form-contrast rather than as evidence for the refined sugar range.

5 | Processing, cooking and preparation

No processing study for metals in this food is in the library yet.

6 | Mitigation for white sugar

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 white sugar for metals

Results depend on the method and its reporting limit. Reporting limits for lead ranged from 0.08 µg/kg (Iyu 2022) to 3,000 µg/kg (WHO GEMS/Food), so a non-detect from a less sensitive method says much less.[1,13] Reporting limits for cadmium ranged from 0.05 µg/kg (Iyu 2022) to 1,000 µg/kg (WHO GEMS/Food), so a non-detect from a less sensitive method says much less.[1,13] Reporting limits for total arsenic ranged from 1.2 µg/kg (Stojanović et al. 2021) to 1,010 µg/kg (WHO GEMS/Food), so a non-detect from a less sensitive method says much less.[1,11]

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

9 | Buying and verifying white sugar

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

10 | Exposure from white sugar

No source in the library converted white sugar 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 white sugar was decided on its content: 29 occurrence extracted, 31 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 | White sugar FAQs

The library reports lead, cadmium, total arsenic, inorganic arsenic, total mercury, methylmercury, nickel, chromium, aluminum, tin, antimony, uranium, Co, Cu, Fe, Mn, Zn, V, Se, Ba, Ca, K, Mg, Sr and Tl in white sugar, most often lead, cadmium and total arsenic.[1,2,3,4] WHO GEMS/Food submissions reported lead in white sugar as sold from 3,255 results in 5 reporting regions, with subgroup medians from 5.3 to 82 µg/kg.[1]

In the studies available, white sugar from contaminated or exposed settings carried more metal than white sugar from the same study's control.[7] white sugar as sold from commercial sample S1 had lead higher at 919 µg/kg, against 426 µg/kg for commercial sample S1 in the same study.[7]

Among GEMS/Food reporting regions, white sugar as sold had the lowest lead subgroup median in PAHO (5.3 µg/kg) and the highest in EURO (82 µg/kg); reporting regions are markets, not growing areas.[1] For cadmium, the lowest regional median was in PAHO (0.2 µg/kg) and the highest in EMRO (23 µg/kg).[1]

Inorganic arsenic, the more toxic form, was measured in 14 results from 5 sources, far fewer than total arsenic.[1,8,14,15,16] Marín et al. 2018 reported inorganic arsenic at 2.1 µg/kg (mean) in white sugar as sold from Sweeteners and condiments group.[8]

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] FY2018-FY2020 TDS Elements Analytical Results
U.S. Food and Drug Administration · FDA Total Diet Study · 2022 · www.fda.gov
DATASET

[3] Contamination by Cadmium and Lead in Sugarcane and Its Derived Products in Ecuador
Alcívar M, Vinueza E, Pernía B, Álvarez-Montero X, and Gallardo A · Agriculture 2024, 14, 2121 · 2024 · doi.org/10.3390/agriculture14122121
PEER-REVIEWED

[4] 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

[5] Determination of some heavy metals and microbial profile of raw Sugar samples collected from Sudanese Sugar Industries in season 2017 in relation to EU.1998 and ICUMSA,1974 standards
Babeker AM, Ahmed AR, Mastafa GI, Abdalla AA, and Bakur A · International Journal of Agricultural Science and Food Technology 8(3): 202-208 · 2022 · doi.org/10.17352/2455-815X.000164
PEER-REVIEWED

[6] Determination of Selected Toxic Heavy Metals and Analysis of Proximate Composition in White Sugar Manufactured from the Omo Kuraz Sugar Factory in Ethiopia
Bekele EE · Research Square (preprint, posted 29 February 2024) · 2024 · doi.org/10.21203/rs.3.rs-3991120/v1
PREPRINT

[7] Multi-Element Characterization and Sustainability Assessment of Traditional Turkish Red Sugar Using Deep Eutectic Solvent Extraction and ICP-MS
Topraksever N · Foods 2026, 15, 3719 · 2026 · doi.org/10.3390/foods15203719
PEER-REVIEWED

[8] Assessment of metal levels in foodstuffs from the Region of Valencia (Spain)
Marín S, Pardo O, Sánchez A, Sanchis Y, Vélez D, Devesa V, et al. · Toxicology Reports 5 (2018) 654-670 · 2018 · doi.org/10.1016/j.toxrep.2018.05.005
PEER-REVIEWED

[9] Differentiation of Confectionery Products Based on Mineral Composition
Grembecka M and Szefer P · Food Analytical Methods 2012, 5: 250-259 · 2012 · doi.org/10.1007/s12161-011-9234-0
PEER-REVIEWED

[10] Infants' and young children's dietary exposures to lead and cadmium: FDA total diet study 2018-2020
Spungen JH and et al. · Food Additives & Contaminants: Part A · 2024 · doi.org/10.1080/19440049.2024.2396910
PEER-REVIEWED

[11] 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

[12] Dietary Exposure to Essential and Toxic Trace Elements in the Portuguese Population: A Total Diet Study Approach
Ventura M, Rego A, Gueifão S, Delgado I, and Coelho I · Foods · 2025 · doi.org/10.3390/foods15050838
PEER-REVIEWED

[13] Characterizing the Exposome of Food Contamination and China Total Diet Study: Project for Improving Food Safety Risk Assessment in China
Iyu · China CDC Weekly · 2022 · doi.org/10.46234/ccdcw2022.039
PEER-REVIEWED

[14] Total Diet Study of metals and other elements in food
Baxter M and Brereton N · Food and Environment Research Agency report for the UK Food Standards Agency, Fera report 15/06, project FS102081 · 2015 · www.food.gov.uk
GOVERNMENT

[15] The First Hong Kong Total Diet Study: Inorganic Arsenic
Centre for Food Safety FEHD HKSAR · Centre for Food Safety, Food and Environmental Hygiene Department, Government of the Hong Kong Special Administrative Region · 2012 · www.cfs.gov.hk
GOVERNMENT

[16] 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
GOVERNMENT

[17] Inorganic Contaminants in Rapadura from Latin America
Milani RF, Rodrigues JL, Henao Toro SJ, Mauri AA, Bragotto APA, and Morgano MA · Foods 2025, 14, 3285 · 2025 · doi.org/10.3390/foods14193285
PEER-REVIEWED

[18] Arbuscular Mycorrhizal Fungi Enhance Antioxidant Defense Systems in Sugarcane Under Soil Cadmium Stress
Paladines-Beltran GM, Venegas NA, and Suarez JC · Plants 2025, 14, 2916 · 2025 · doi.org/10.3390/plants14182916
PEER-REVIEWED

STATUS AND LICENCE

Editorially reviewed in-house; no external peer review has been completed on this ingredient profile. Published as an

COMPETING INTERESTS

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DATA AVAILABILITY

Every source behind this ingredient profile is listed with its own source record at https://heavymetalindex.com/ingredients/white-sugar#sources.

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