Legumes

Karen Pendergrass · Heavy Metal Index, Institute of Contaminant Standards

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Abstract

Legumes in the HMI library has 1,378 reported results for lead, cadmium, total arsenic, inorganic arsenic, dimethylarsinic acid, monomethylarsonic acid, total mercury, nickel, chromium, aluminum, tin, antimony, uranium, Co, Cu, Fe, Mn, Zn, V, Se, Ag, As, B, Ba, Ca, Hg, I, K, Mg, Mo, Na, Sr, Ti and Tl from 90 sources. WHO gems/food submissions reported lead in legumes as sold from 6,059 results in 5 reporting regions, with subgroup medians from 1.1 to 430 µg/kg. In the US Total Diet Study, canned legumes had a median lead result below 4 µg/kg across 3 composites from 2018-2020.

1 | Legumes overview

Across 12 other studies of ordinary farms and markets, reported lead means and medians on an as-sold or fresh-weight basis ranged from 4.5 µg/kg (Yu et al. 2023) to 12,600 µg/kg (Chowdhury et al. 2024).[7,8] For cadmium, 18 studies on an as-sold or fresh-weight basis reported means and medians from 2 µg/kg (Guerra et al. 2012) to 300 µg/kg (Korfali et al. 2013).[9,10]

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

2 | What counts as legumes

This page covers legumes in 6 forms kept separate in every comparison: legumes as sold (1,013 results), canned legumes (164 results), dried legumes (137 results), frozen legumes (32 results), cooked legumes (29 results) and legumes oil (3 results).[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.

3 | How metals reach legumes

No study in the library compared legumes from contaminated and ordinary settings, so the routes by which metals reach it are not measured here.

4 | Which forms and regions measured lower

For cadmium, the HMI dried reference median was lowest for legumes (4.77 µg/kg) canned and highest for legumes (250 µg/kg); forms differ in water content, so this compares foods as sold or eaten, not uptake.[7,11] The hmi reference for lead in legumes as sold pools 26 subgroup units from 5 sampling families, with a median of below 5.1 µg/kg and a middle half spanning below 0.83 (lower quartile) and 82 µg/kg (upper quartile).[1,24,25,26,27] canned for lead in legumes, the reference median was below 4 µg/kg, with a middle half from below 4 to below 110 µg/kg across 10 units.[2,28,29] for lead in legumes as sold, the reference median was between 400 and 520 µg/kg, with a middle half from below 12.3 to between 835 and 1,150 µg/kg across 417 units.[1,30]

Among GEMS/Food reporting regions, legumes as sold had the lowest lead subgroup median in PAHO (1.1 µg/kg) and the highest in WPRO (90 µg/kg); reporting regions are markets, not growing areas.[1] For cadmium, the lowest regional median was in AFRO (1 µg/kg) and the highest in EURO (43 µg/kg).[1] For total arsenic, the lowest regional median was in WPRO (1 µg/kg) and the highest in EURO (16.1 µg/kg).[1]

Targeted legumes as sold samples in EURO had aluminum lower at 1,410 µg/kg, against 1,870 µg/kg for EURO in the same study.[1]

In one study, lead across 18 groups of legumes ranged from 1.1 µg/kg (PAHO) to 90 µg/kg (WPRO); the lowest is the lowest observed in that study, not an established sourcing preference.[1] In another study, lead across 5 groups of legumes ranged from 120 µg/kg (Ottawa 1985 (preliminary study)) to 332 µg/kg (Montreal 1988); the lowest is the lowest observed in that study, not an established sourcing preference.[31]

5 | Processing, cooking and preparation

Processed or prepared forms were compared only with unprocessed legumes in the same study and group. Canned legumes (Legume, Riyadh city markets, May 2009) had lead higher at 19 µg/kg, against 14 µg/kg for the unprocessed form in the same group (legumes as sold).[32] In another study, canned legumes (5 city composites) had lead higher at 152 µg/kg, against 21.7 µg/kg for the unprocessed form in the same group (legumes as sold).[31] dried a third study found that legumes (all samples (both areas)) had lead lower at 54 µg/kg, against 55.7 µg/kg for the unprocessed form in the same group (legumes as sold).[33]

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

6 | Mitigation for legumes

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

7 | Trade-offs and limits of controls

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 legumes for metals

Results depend on the method and its reporting limit. Reporting limits for lead ranged from 0.045 µg/kg (Kharkwal et al. 2023) to 3,000 µg/kg (WHO GEMS/Food), so a non-detect from a less sensitive method says much less.[1,19] Reporting limits for cadmium ranged from 0.006 µg/kg (Kharkwal et al. 2023) to 1,000 µg/kg (WHO GEMS/Food), so a non-detect from a less sensitive method says much less.[1,19] Reporting limits for total arsenic ranged from 0.009 µg/kg (Kharkwal et al. 2023) to 2,500 µg/kg (WHO GEMS/Food), so a non-detect from a less sensitive method says much less.[1,19]

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

9 | Buying and verifying legumes

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

10 | Exposure from legumes

No source in the library converted legumes 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 legumes was decided on its content: 90 occurrence extracted, 90 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 | Legumes FAQs

The library reports lead, cadmium, total arsenic, inorganic arsenic, dimethylarsinic acid, monomethylarsonic acid, total mercury, nickel, chromium, aluminum, tin, antimony, uranium, Co, Cu, Fe, Mn, Zn, V, Se, Ag, As, B, Ba, Ca, Hg, I, K, Mg, Mo, Na, Sr, Ti and Tl in legumes, most often lead, cadmium and total arsenic.[1,2,3,4] WHO gems/food submissions reported lead in legumes as sold from 6,059 results in 5 reporting regions, with subgroup medians from 1.1 to 430 µg/kg.[1]

For cadmium, the HMI dried reference median was lowest for legumes (4.77 µg/kg) canned and highest for legumes (250 µg/kg); forms differ in water content, so this compares foods as sold or eaten, not uptake.[7,11]

Among GEMS/Food reporting regions, legumes as sold had the lowest lead subgroup median in PAHO (1.1 µg/kg) and the highest in WPRO (90 µg/kg); reporting regions are markets, not growing areas.[1] For cadmium, the lowest regional median was in AFRO (1 µg/kg) and the highest in EURO (43 µg/kg).[1]

Only comparisons between forms in the same study are available, not before-and-after measurements of the same legumes.[32] canned legumes (Legume, Riyadh city markets, May 2009) had lead higher at 19 µg/kg, against 14 µg/kg for the unprocessed form in the same group (legumes as sold).[32]

Inorganic arsenic, the more toxic form, was measured in 37 results from 6 sources, far fewer than total arsenic.[1,34,35,36,37,38] Across 2 other studies of ordinary farms and markets, reported inorganic arsenic means and medians on an as-sold or fresh-weight basis ranged from 4.9 µg/kg (Marín et al. 2018) to 800 µg/kg (Laizu 2007).[34,35]

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STATUS AND LICENCE

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DATA AVAILABILITY

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

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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