Milk and Dairy

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Abstract

Milk and dairy in the HMI library has 6,521 reported results for lead, cadmium, total arsenic, inorganic arsenic, dimethylarsinic acid, monomethylarsonic acid, total mercury, methylmercury, nickel, chromium, aluminum, tin, antimony, uranium, Co, Cu, Fe, Mn, Zn, V, Se, Ag, As, AsIII, AsV, B, Ba, Be, Bi, Ca, Cr(III), CrIII, CrVI, Ga, Hg, I, K, Li, Mg, Mo, Na, P, Pt, Si, Sr, Ti, Tl and W from 155 sources. WHO GEMS/Food submissions reported lead in milk and dairy as sold from 15,931 results in 5 reporting regions, with subgroup medians from 1.48 to 370 µg/kg. In the US Total Diet Study, milk and dairy as sold had a median lead result below 4 µg/kg across 3 composites from 2018-2020.

1 | Milk and dairy overview

Across 32 other studies of ordinary farms and markets, reported lead means and medians on an as-sold or fresh-weight basis ranged from 0.29 µg/kg (Dabeka et al. 1987) to 20,600 µg/kg (Budaraga et al. 2022).[7,8] For cadmium, 40 studies on an as-sold or fresh-weight basis reported means and medians from 0.008 µg/kg (Dabeka et al. 1987) to 1,310 µg/kg (Sadeghi et al. 2020).[7,9] Higher results came from contaminated or exposed settings rather than ordinary supply. Milk and dairy peel or outer layer from D2, 250-500 m from brick kilns (industrial-affected area) had lead higher at 740 µg/kg, against 110 µg/kg for D0 control area, Tankipora (no kiln within 1500 m) in the same study.[10]

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

2 | What counts as milk and dairy

This page covers milk and dairy in 8 forms kept separate in every comparison: milk and dairy as sold (6,386 results), milk and dairy powder or ground (70 results), canned milk and dairy (34 results), milk and dairy peel or

outer layer (12 results), milk and dairy flour or meal (8 results), cooked milk and dairy (4 results), milk and dairy oil (4 results) dried and milk and dairy (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 milk and dairy

The evidence on how metals reach milk and dairy comes from studies that compared exposed and ordinary settings. Milk and dairy peel or outer layer from D2, 250-500 m from brick kilns (industrial-affected area) had lead higher at 740 µg/kg, against 110 µg/kg for D0 control area, Tankipora (no kiln within 1500 m) in the same study.[10] In another study, milk and dairy as sold from commercial/retail, conventional, packaged had tin higher at 13.1 µg/kg, against 3 µg/kg for Buffalo milk (conventional farm, Satu Mare County) in the same study.[19] A third study found that milk and dairy as sold from conventional, summer had Mn higher at 100 µg/kg, against 40 µg/kg for all samples (conventional and organic, summer and winter) in the same study.[49]

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 milk and dairy as sold pools 580 subgroup units from 16 sampling families, with a median of below 4 µg/kg and a middle half spanning below 1.34 (lower quartile) and between 1.44 and 24 µg/kg (upper quartile).[1,2,7,13,17,20,23,49,50,51,52,53,54,55,56,57] for lead in milk and dairy powder or ground, the reference median was 2 µg/kg, with a middle half from below 2 to between 2 and 13.1 µg/kg across 26 units.[1,58] for lead in milk and dairy as sold, the reference median was below 40 µg/kg, with a middle half from below 40 to below 40 µg/kg across 4 units.[1]

Among GEMS/Food reporting regions, milk and dairy as sold had the lowest lead subgroup median in PAHO (1.48 µg/kg) and the highest in EURO (370 µg/kg); reporting regions are markets, not growing areas.[1] For cadmium, the lowest regional median was in PAHO (0.23 µg/kg) and the highest in PAHO (37.5 µg/kg).[1] For total arsenic, the lowest regional median was in EURO (0.983 µg/kg) and the highest in WPRO (60 µg/kg).[1]

Cooked targeted milk and dairy samples in EURO had cadmium higher at 80 µg/kg, against 17 µg/kg for EURO in the same study.[1]

In one study, lead across 67 groups of milk and dairy ranged from 10 µg/kg (retail brand 11 of 15, Tehran market) to 660 µg/kg (Tehran district 17, bulk milk tanks); the lowest is the lowest observed in that study, not an established sourcing preference.[9] In another study, lead across 39 groups of milk and dairy ranged from 0.2 µg/kg (unbranded raw cow milk, Kasuwar Barchi, Kaduna) to 4 µg/kg (unbranded raw cow milk, Panteka, Kaduna); the lowest is the lowest observed in that study, not an established sourcing preference.[54]

5 | Processing, cooking and preparation

Processed or prepared forms were compared only with unprocessed milk and dairy in the same study and group. Canned milk and dairy (all samples) had lead higher at 71.9 µg/kg, against 1.19 µg/kg for the unprocessed form in the same group (milk and dairy as sold).[7] In another study, canned milk and dairy (5 city composites) had lead higher at 20.5 µg/kg, against 13.5 µg/kg for the unprocessed form in the same group (milk and dairy as sold).[59]

A third dried study found that milk and dairy (European dietary-survey occurrence data) had inorganic arsenic higher at 18.2 µg/kg, against 15.5 µg/kg for the unprocessed form in the same group (milk and dairy as sold).[60]

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

6 | Mitigation for milk and dairy

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.[10] 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 milk and dairy for metals

Results depend on the method and its reporting limit. Reporting limits for lead ranged from 0.01 µg/kg (Nwoke et al. 2021) to 4,000 µg/kg (WHO GEMS/Food), so a non-detect from a less sensitive method says much less.[1,53] Reporting limits for cadmium ranged from 0.017 µg/kg (Zmudzinska et al. 2022) to 1,200 µg/kg (WHO GEMS/Food), so a non-detect from a less sensitive method says much less.[1,61] Reporting limits for total arsenic ranged from 0.019 µg/kg (Zmudzinska et al. 2022) to 11,600 µg/kg (WHO GEMS/Food), so a non-detect from a less sensitive method says much less.[1,61]

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

9 | Buying and verifying milk and dairy

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

10 | Exposure from milk and dairy

No source in the library converted milk and dairy 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 milk and dairy was decided on its content: 155 occurrence extracted, 155 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 | Milk and dairy FAQs

The library reports lead, cadmium, total arsenic, inorganic arsenic, dimethylarsinic acid, monomethylarsonic acid, total mercury, methylmercury, nickel, chromium, aluminum, tin, antimony, uranium, Co, Cu, Fe, Mn, Zn, V,

Se, Ag, As, AsIII, AsV, B, Ba, Be, Bi, Ca, Cr(III), CrIII, CrVI, Ga, Hg, I, K, Li, Mg, Mo, Na, P, Pt, Si, Sr, Ti, Tl and W in milk and dairy, most often lead, cadmium and total arsenic.[1,2,3,4] WHO GEMS/Food submissions reported lead in milk and dairy as sold from 15,931 results in 5 reporting regions, with subgroup medians from 1.48 to 370 µg/kg.[1]

In the studies available, milk and dairy from contaminated or exposed settings carried more metal than milk and dairy from the same study's control.[4] milk and dairy as sold from 20 contaminated milk samples before adsorbent treatment had lead higher at 363 µg/kg, against 212 µg/kg for pasteurized cow milk, El-Qalyubia dairy shops in the same study.[4]

Among GEMS/Food reporting regions, milk and dairy as sold had the lowest lead subgroup median in PAHO (1.48 µg/kg) and the highest in EURO (370 µg/kg); reporting regions are markets, not growing areas.[1] For cadmium, the lowest regional median was in PAHO (0.23 µg/kg) and the highest in PAHO (37.5 µg/kg).[1]

Only comparisons between forms in the same study are available, not before-and-after measurements of the same milk and dairy.[7] canned milk and dairy (all samples) had lead higher at 71.9 µg/kg, against 1.19 µg/kg for the unprocessed form in the same group (milk and dairy as sold).[7]

Inorganic arsenic, the more toxic form, was measured in 60 results from 7 sources, far fewer than total arsenic.[1,11,12,62,63,64,60] 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 0.6 µg/kg (Marín et al. 2018) to 7 µg/kg (Food Standards Agency 2014).[11,12]

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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.

DATA AVAILABILITY

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

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