# Peppers

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## Abstract

Peppers in the HMI library has 829 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, Ag, B, Ba, Be, Ca, K, Mg, Mo, P, Sr and Ti from 47 sources. WHO gems/food submissions reported lead in peppers as sold from 5,500 results in 6 reporting regions, with subgroup medians from 0.04 to 6,740 µg/kg. For cadmium, GEMS/Food gave subgroup medians from 4 to 108 µg/kg from 2,698 results.

## 1 | Peppers overview

Across 7 other studies of ordinary farms and markets, reported lead means and medians on an as-sold or fresh-weight basis ranged from 5 µg/kg (Antoine et al. 2017) to 4,640 µg/kg (Awoyale et al. 2024).[2,7] For cadmium, 6 studies on an as-sold or fresh-weight basis reported means and medians from 3.8 µg/kg (Norton et al. 2015) to 157 µg/kg (Antoine et al. 2017).[2,8] Higher results came from contaminated or exposed settings rather than ordinary supply. Peppers as sold from Location B1 (industrial-affected area) had total mercury higher at 62.1 µg/kg, against 0.93 µg/kg for Control (grocery store >55 km from any power plant) in the same study.[9]

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

## 2 | What counts as peppers

This page covers peppers in 3 forms kept separate in every comparison: peppers as sold (684 results), peppers powder or ground (111 results) dried and peppers (34 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 peppers

The evidence on how metals reach peppers comes from studies that compared exposed and ordinary settings. Peppers as sold from Location B1 (industrial-affected area) had total mercury higher at 62.1 µg/kg, against 0.93 µg/kg for Control (grocery store >55 km from any power plant) in the same study.[9] In another study, peppers as sold from harvest C4 (mining-affected area) had total mercury higher at 0.4 µg/kg, against 0.1 µg/kg for harvest C1 in the same study.[18] a third study found that peppers powder or ground from laboratory-prepared control had total arsenic higher at 21,800 µg/kg, against 17,100 µg/kg for all seven samples in Table 2, including the laboratory control 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

For lead, the HMI reference median was lowest for peppers as sold (25 µg/kg) dried and highest for peppers (154 µg/kg); forms differ in water content, so this compares foods as sold or eaten, not uptake.[1] The hmi reference for lead in peppers as sold pools 189 subgroup units from 3 sampling families, with a median of below 30 µg/kg and a middle half spanning below 30 (lower quartile) and between 30 and 4,140 µg/kg (upper quartile).[1,3,19] for lead in peppers as sold, the reference median was between 30 and 50 µg/kg, with a middle half from below 50 to 50,200 µg/kg across 18 units.[1,10,20] dried for lead in peppers, the reference median was between 161 and 170 µg/kg, with a middle half from between 47.5 and 96.8 to between 265 and 270 µg/kg across 39 units.[1]

Among GEMS/Food reporting regions, peppers as sold had the lowest lead subgroup median in SEARO (0.04 µg/kg) and the highest in EURO (6,740 µg/kg); reporting regions are markets, not growing areas.[1] For cadmium, the lowest regional median was in AFRO (4 µg/kg) and the highest in PAHO (108 µg/kg).[1] For total mercury, the lowest regional median was in EURO (5.5 µg/kg) and the highest in WPRO (10 µg/kg).[1]

Targeted peppers as sold samples in EURO had lead higher at 29.3 µg/kg, against 10.3 µg/kg for EURO in the same study.[1] In another study, targeted peppers as sold samples in EURO had lead higher at 20 µg/kg, against 10.3 µg/kg for EURO in the same study.[1]

In one study, lead across 14 groups of peppers ranged from 0.04 µg/kg (SEARO) to 218 µg/kg (PAHO); the lowest is the lowest observed in that study, not an established sourcing preference.[1] In another study, lead across 12 groups of peppers ranged from 2 µg/kg (Shasha market, Osogbo (traffic-free market)) to 9 µg/kg (Olu-Ode market, Osogbo (high-traffic market)); the lowest is the lowest observed in that study, not an established sourcing preference.[21]

## 5 | Processing, cooking and preparation

Processed or prepared forms were compared only with unprocessed peppers in the same study and group. Peppers powder or ground (ingredient for canned meatballs in tomato sauce) had lead lower at 20 µg/kg, against 30 µg/kg for the unprocessed form in the same group (peppers as sold).[19] In another study, dried peppers (EURO) had lead higher at 270 µg/kg, against 10.3 µg/kg for the unprocessed form in the same group (peppers as sold).[1]

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

## 6 | Mitigation for peppers

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.[9] 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 peppers for metals

Results depend on the method and its reporting limit. Reporting limits for lead ranged from 0.5 µg/kg (Al-Salimi et al. 2026) to 5,000 µg/kg (WHO GEMS/Food), so a non-detect from a less sensitive method says much less.[1,22] Reporting limits for cadmium ranged from 0.1 µg/kg (Al-Salimi et al. 2026) to 100 µg/kg (WHO GEMS/Food), so a non-detect from a less sensitive method says much less.[1,22] Reporting limits for total arsenic ranged from 1 µg/kg (WHO GEMS/Food) to 1,000 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 peppers

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

## 10 | Exposure from peppers

No source in the library converted peppers 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 peppers was decided on its content: 47 occurrence extracted, 47 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 | Peppers 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, Ag, B, Ba, Be, Ca, K, Mg, Mo, P, Sr and Ti in peppers, most often lead, cadmium and total arsenic.[1,2,3,4] WHO gems/food submissions reported lead in peppers as sold from 5,500 results in 6 reporting regions, with subgroup medians from 0.04 to 6,740 µg/kg.[1]

In the studies available, peppers from contaminated or exposed settings carried more metal than peppers from the same study's control.[7] peppers powder or ground from laboratory-prepared control had total arsenic higher at 21,800 µg/kg, against 17,100 µg/kg for all seven samples in Table 2, including the laboratory control in the same study.[7]

For lead, the HMI reference median was lowest for peppers as sold (25 µg/kg) dried and highest for peppers (154 µg/kg); forms differ in water content, so this compares foods as sold or eaten, not uptake.[1]

Among GEMS/Food reporting regions, peppers as sold had the lowest lead subgroup median in SEARO (0.04 µg/kg) and the highest in EURO (6,740 µg/kg); reporting regions are markets, not growing areas.[1] For cadmium, the lowest regional median was in AFRO (4 µg/kg) and the highest in PAHO (108 µg/kg).[1]

Only comparisons between forms in the same study are available, not before-and-after measurements of the same peppers.[19] peppers powder or ground (ingredient for canned meatballs in tomato sauce) had lead lower at 20 µg/kg, against 30 µg/kg for the unprocessed form in the same group (peppers as sold).[19]

Inorganic arsenic, the more toxic form, was measured in 15 results from 4 sources, far fewer than total arsenic.[1,6,23,24] European Food Safety Authority (EFSA) 2014 reported inorganic arsenic at 69.9 µg/kg (mean) in peppers as sold from European dietary-survey occurrence data.[24]

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## STATUS AND LICENCE

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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/peppers#sources.

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