Kale

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Abstract

Kale in the HMI library has 117 reported results for lead, cadmium, total arsenic, inorganic arsenic, total mercury, nickel, chromium, aluminum, tin, antimony, uranium, Co, Cu, Fe, Mn, Zn, V, Se, As, Ba, Hg and Mo from 11 sources. WHO gems/food submissions reported lead in kale as sold from 484 results in 4 reporting regions, with subgroup medians from 2 to 2,890 µg/kg. In the US Total Diet Study, cooked kale had a median lead result below 4 µg/kg across 6 composites from 2019-2020.

1 | Kale overview

Across 4 other studies of ordinary farms and markets, reported lead means and medians on an as-sold or fresh-weight basis ranged from 3.2 µg/kg (Spungen et al. 2024) to 130 µg/kg (Kim et al. 2024).[4,7] For cadmium, 4 studies on an as-sold or fresh-weight basis reported means and medians from 6.5 µg/kg (Norton et al. 2015) to 30 µg/kg (Kim et al. 2024).[4,5]

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

2 | What counts as kale

This page covers kale in 2 forms kept separate in every comparison: kale as sold (108 results) cooked and kale (9 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 kale

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

4 | Which forms and regions measured lower

The hmi reference for lead in kale as sold pools 35 subgroup units from 2 sampling families, with a median of between 15 and 20 µg/kg and a middle half spanning 12.8 (lower quartile) and 102 µg/kg (upper quartile).[1,5] cooked for lead in kale, the reference median was below 4 µg/kg, with a middle half from below 4 to 4.8 µg/kg across 6 units.[2] for cadmium in kale as sold, the reference median was between 11.6 and 12.2 µg/kg, with a middle half from 6.5 to between 12.6 and 14 µg/kg across 34 units.[1,5]

Among GEMS/Food reporting regions, kale as sold had the lowest lead subgroup median in SEARO (2 µg/kg) and the highest in SEARO (135 µg/kg); reporting regions are markets, not growing areas.[1] For cadmium, the lowest regional median was in EURO (4.45 µg/kg) and the highest in PAHO (40.2 µg/kg).[1]

Targeted kale as sold samples in WPRO had lead higher at 2,890 µg/kg, against 12.5 µg/kg for WPRO in the same study.[1] In another study, targeted kale as sold samples in WPRO had cadmium higher at 2,430 µg/kg, against 18.5 µg/kg for WPRO in the same study.[1]

5 | Processing, cooking and preparation

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

6 | Mitigation for kale

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 kale for metals

Results depend on the method and its reporting limit. Reporting limits for lead ranged from 0.5 µg/kg (WHO GEMS/Food) to 150 µg/kg (WHO GEMS/Food), so a non-detect from a less sensitive method says much less.[1] Reporting limits for cadmium ranged from 0.08 µg/kg (WHO GEMS/Food) to 29 µg/kg (WHO GEMS/Food), so a non-detect from a less sensitive method says much less.[1] Reporting limits for total arsenic ranged from 1.25 µg/kg (WHO GEMS/Food) to 250 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 kale

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

10 | Exposure from kale

No source in the library converted kale 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 kale was decided on its content: 11 occurrence extracted, 11 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 | Kale FAQs

The library reports lead, cadmium, total arsenic, inorganic arsenic, total mercury, nickel, chromium, aluminum, tin, antimony, uranium, Co, Cu, Fe, Mn, Zn, V, Se, As, Ba, Hg and Mo in kale, most often lead, cadmium and total arsenic.[1,2,3,4] WHO gems/food submissions reported lead in kale as sold from 484 results in 4 reporting regions, with subgroup medians from 2 to 2,890 µg/kg.[1]

Among GEMS/Food reporting regions, kale as sold had the lowest lead subgroup median in SEARO (2 µg/kg) and the highest in SEARO (135 µg/kg); reporting regions are markets, not growing areas.[1] For cadmium, the lowest regional median was in EURO (4.45 µg/kg) and the highest in PAHO (40.2 µg/kg).[1]

Inorganic arsenic, the more toxic form, was measured in 6 results from 2 sources, far fewer than total arsenic.[1,8] Centre for Food Safety FEHD HKSAR 2012 reported inorganic arsenic at 3 µg/kg (mean) in kale as sold from all samples (4 sampling occasions, composites).[8]

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GOVERNMENT

STATUS AND LICENCE

Editorially reviewed in-house; no external peer review has been completed on this ingredient profile. Published as an institutional technical report with its review state tracked on the article page. Released under CC BY 4.0.

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/kale#sources.

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