Spinach and similar leaves: HMTc Standard

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CORRESPONDENCE

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KEYWORDS

heavy metals, food safety, dietary exposure

PUBLICATION HISTORY

This revision 2026-08.

Abstract

The Heavy Metal Tested & Certified heavy-metal-safety standard for spinach and similar leaves in Fruits, Vegetables, and Produce, evaluated on fresh or frozen spinach as sold, wet weight, edible portion after washing and separation of the edible part. 6 of 11 panel analytes publish a numeric limit taken from the strictest applicable government maximum; the remainder are held under mandatory control or a substantiated not-material determination.

1 | How every number on this standard is set

HMTc Method v2.0 (government-limit-only; the strictest applicable sovereign maximum level for the row's product form in the row's native basis, a disclosed read-across where the exact cell is unregulated, a substantiated not-material determination, or a control; never occurrence-derived)

2 | Master limit table

All values in ppb (µg/kg), as sold basis. A brand meeting every value qualifies for the mark.

ANALYTE	HMTC LIMIT	BASIS
Lead (Pb)	100	government maximum level (Australia / New Zealand)
Cadmium (Cd)	100	government maximum level (Australia / New Zealand)
Total arsenic (tAs)	300	government maximum level (Mercosur)

Inorganic arsenic (iAs)	60	government maximum level (Israel)
Mercury, total (tHg)	10	government maximum level (Hong Kong)
Methylmercury (MeHg)	control	measured every lot; no human-food maximum
Nickel (Ni)	500	government maximum level (EU 2024/1987)
Tin (Sn)	n/m	not material in this matrix
Aluminium (Al)	control	measured every lot; no human-food maximum
Total chromium (Cr)	500	screening ceiling (Hong Kong)
Hexavalent chromium (Cr-VI)	n/m	not material in this matrix

3 | Derivation — where each number comes from

Every cell traces to one named sovereign maximum level (the strictest for the nearest analog), or to an explicit control, not-material, or species-bounded determination. No occurrence statistic selects a certification value.

ANALYTE	HMTC	SOVEREIGN ANALOG / DETERMINATION
Lead (Pb)	100	government maximum level (Australia / New Zealand)
Cadmium (Cd)	100	government maximum level (Australia / New Zealand)
Total arsenic (tAs)	300	government maximum level (Mercosur)
Inorganic arsenic (iAs)	60	government maximum level (Israel)
Mercury, total (tHg)	10	government maximum level (Hong Kong)

Methylmercury (MeHg)	control	No credible sovereign government sets a methylmercury maximum level for this product form, and no not-material determination is supportable for it: the routed corpus quantifies methylmercury in edible plant and fungal tissue (wang2021-houttuynia--mercury-china measured methylmercury in the leaf and root tissue of an edible leafy vegetable at an LOD of 0.002 ug/kg; stasinos2014-heavy--metals-tubers-review in root and tuber tissue; asensio2023--madrid-mushrooms-mercury), so the species is not absent from produce and the biological premise of a not-material determination is rebutted inside this very category. Spinach is a leaf vegetable, so wang2021--houttuynia-mercury-china is a measurement in the same tissue type and the same product class as this row; the sibling leafy-vegetables-other, non-root-vegetables and root--tuber-vegetables rows reject the same not-material claim on the same evidence, and this row is aligned with them rather than published on the opposite treatment. Methylmercury is therefore held under mandatory analytical control rather than recorded not-material, and it remains bounded by identity below the published total-mercury ceiling for this row (Hong Kong Cap. 132V item 12, 10 ug/kg); methylmercury cannot exceed total mercury. No methylmercury ceiling is invented.
Nickel (Ni)	500	government maximum level (EU 2024/1987)

Tin (Sn)	n/m	Every tin maximum level in the register is scoped to canned product: EU Reg. 2023/915 sets 200000 ug/kg for canned foods and 100000 ug/kg for canned beverages, Codex CXS 193-1995 and AU-NZ Schedule 19 set 250000 ug/kg for canned foods, and Hong Kong Cap. 132V sets 250000 ug/kg for canned food other than canned beverages. Those limits regulate one contamination pathway, dissolution of tin from tinplate into the packed food. This row is not packed in tinplate, so the pathway that every sovereign tin limit addresses is physically absent and any tin present is dietary background rather than packaging migration. Fresh and frozen spinach is sold loose, bagged or in polymer clamshells. Hermetically sealed tinplate presentations of this commodity route to the canned-foods row in Category 7 and carry the canned-foods tin maximum level there.
Aluminium (Al)	control	No credible sovereign government sets an aluminium contaminant maximum level for any fruit, vegetable or produce form in any jurisdiction. The register's aluminium limits are drinking-water and bottled-water parameters, infant-formula maximum levels, a food-contact plastics specific migration limit, toy migration limits, and permitted-additive levels for baked and starch foods; none of them regulates aluminium as a contaminant of produce. Aluminium is also the third most abundant element in the earth's crust and appears in produce largely as soil-derived and root-associated mineral content rather than as process contamination, so no near-neighbour read-across is supportable either. Under the government-limit-only method HMTc publishes no standalone aluminium number for this row.
Total chromium (Cr)	500	screening ceiling (Hong Kong)

Hexavalent chromium (Cr-VI)	n/m	No credible sovereign government sets a hexavalent-chromium maximum level for any solid food in any jurisdiction. The register's only INGESTED Cr(VI) parameters are drinking-water maxima (Australia NHMRC 2025, 50 ug/L, nhmrc2025_crvi_drinking_water_-50; California SWRCB, 10 ug/L, us_ca_swrcb_2024_cr-vi_-chromium-hexavalent_mcl_10ugl and ca_swrcb_crvi_drinking_water_-10), which are water-basis parameters expressed per litre of a consumed liquid and supply no applicable ceiling for a solid produce row in this row's native basis; every remaining Cr(VI) row in the register is an article or material limit (toys, textiles, leather, fertilisers, electrical equipment). Chromium in produce is dominated by nutritionally essential Cr(III), and Cr(VI) is not stable in the plant matrix: fruit and vegetable tissue is an aqueous, organic-acid and ascorbate-rich reducing medium in which Cr(VI) is reduced to Cr(III), so a reported Cr(VI) value in this matrix reflects extraction conditions rather than the chromium species the consumer ingests. Hexavalent chromium is therefore bounded by the published total-chromium screen for this row (Hong Kong Cap. 132V item 7, 500 ug/kg) and controlled by reflex speciation rather than by a published number.

4 | Cite this standard

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References

[1] Australia / New Zealand
Binds Pb, Cd.
MAXIMUM LEVEL

[2] Mercosur
Binds tAs.
MAXIMUM LEVEL

[3] Hong Kong
Binds tHg, Cr.
MAXIMUM LEVEL

[4] EU 2024/1987
Binds Ni.
MAXIMUM LEVEL

[5] Israel
Binds iAs.
MAXIMUM LEVEL

STATUS AND LICENCE

A normative certification standard, editorially reviewed and version-controlled in-house; every value traces to a named sovereign maximum level, disclosed in the derivation. © 2026 Institute of Contaminant Standards / Heavy Metal Certified. All rights reserved.

COMPETING INTERESTS

This standard is published by the Heavy Metal Tested & Certified (HMTc) program, operated by the Institute of Contaminant Standards. Its statements about government regulations, toxicology, and occurrence are sourced to the cited primary and expert-body records and to the independently maintained Heavy Metal Index; the program's own certification thresholds are not used as evidence for any factual claim made here.

DATA AVAILABILITY

The works this standard draws on are listed in full in the references above and on the standard page at https://heavymetalcertified.com/standards/spinach. Primary legal instruments and expert-body assessments are named with their public identifiers; the underlying occurrence and toxicology corpus is maintained on the Heavy Metal Index.

PUBLICATION HISTORY

This revision 2026-08. The full dated record is maintained at https://heavymetalcertified.com/standards/spinach.