

Heavy Metals in Cassava Products

GOALS

To gauge the levels of heavy metals, particularly lead, in various foods made from cassava and to inform the public about any health concerns and safer options available, CR tested 27 cassava products belonging to the following food categories: bars, bread, cereal, chips, cookies, crackers, flour, pasta, puffs, and soda.

TEST APPROACH AND METHODS

At least three samples from one to three different lots for 27 different products were sent to a certified lab for total cadmium, lead, mercury, and arsenic testing using Inductively Coupled Plasma – Triple Quadrupole Mass Spectrometry (ICP-QQQ MS) according to method AOAC 2015.01 Modified.

We reviewed all the test results and quality control data provided by the contract lab for accuracy and clarity.

DATA ANALYSIS

To estimate the average concentration of a heavy metal in a tested model, we applied a method used by many risk assessors, including the Environmental Protection Agency.^{1,2} If a heavy metal was detected (greater than the method detection limit, or MDL) in any of the samples tested of the model, the samples that had test results below the MDL were assumed to have a concentration of half the MDL for that heavy metal. If the heavy metal was not detected in any of the samples tested of the model, we assumed a concentration of zero for all the samples of that model for the heavy metal. This approach to risk assessment appropriately considered important uncertainties about potential levels of undetected risk in samples with test results below the MDL.

EXPOSURE ASSESSMENT

We determined the estimated intake of total arsenic, cadmium, and lead per serving of each product. (We did not detect mercury in any of the products.) The results of

our tests are shown in the chart on page 3 and are listed in micrograms (mcg) per serving and in parts per billion (ppb). We used several published health-based exposure limits to inform our assessment (see table below).

Arsenic: Noncancer exposure risks were calculated by the Hazard Quotient (HQ)³ Method and the following equation:

HQ = Exposure Dose/Reference Dose.

An HQ >1 would indicate that consumption of one serving per day would pose a comparatively higher health risk.

We estimated a 75-kilogram (165-pound) adult's intake of total arsenic from the tested levels in a serving of each product and compared the intake estimate to the exposure limit for inorganic arsenic in the table on page 1. Inorganic arsenic was not measured because total arsenic levels were not high enough to pose a health risk based on CR's risk

Health-Based Exposure Limits Informing CR's Exposure Assessments for Heavy Metals

Heavy Metal	EPA RfD, mcg/kg bw/d	OEHHA MADL, mcg/day	FDA IRL (children), mcg/day	FDA IRL (women of child-bearing age), mcg/day
Inorganic Arsenic	0.1 ⁴	NA	NA	NA
Cadmium	NA	4.1 ⁵	NA	NA
Lead	NA	0.5 ⁶	2.2 ⁷	8.8 ⁷

OEHHA = California Office of Environmental Health Hazard Assessment.
MADL = Maximum Allowable Dose Level.
RfD = Oral Reference Dose.
NA = Not applicable.

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¹Xue, J., Zartarian, V., Wang, S., et al., Probabilistic Modeling of Dietary Arsenic Exposure and Dose and Evaluation with 2003-2004 NHANES Data, Environmental Health Perspectives, 118, no. 3 (2010): 345-50 ([Link](#)).

²Regional Guidance on Handling Chemical Concentration Data Near the Detection Limit in Risk Assessments, Environmental Protection Agency ([Link](#)).

³Risk Assessment for Other Effects, Environmental Protection Agency. ([Link](#)).

⁴U.S. Environmental Protection Agency Integrated Risk Information System (IRIS) Chemical Assessment Summary, Arsenic, inorganic ([Link](#)).

⁵State of California, OEHHA, Cadmium ([Link](#)).

⁶State of California, OEHHA, Lead ([Link](#)).

⁷Flannery, BM and Middleton, KB. Updated interim reference levels for dietary lead to support FDA's Closer to Zero action plan, Regulatory Toxicology and Pharmacology, 133 (2022) ([Link](#)).

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assessment for a person 2 years or older consuming up to two servings of each food per day.

Cadmium and lead: To assess the risk from cadmium and lead posed by the products, CR used the California Office of Environmental Health Hazard Assessment (OEHHA) Maximum Allowable Dose Levels (MADL) as the benchmarks for CR's levels of concern. MADLs are levels established through California's Proposition 65 law. CR uses these values because the standards are the most protective available. A CR level of concern >100 would indicate that consumption of one serving per day would pose a comparatively higher health risk.

However, while we use the MADLs involved in Prop 65, we approach our exposure assessment differently from what's outlined in Prop 65. Prop 65 takes into consideration consumers' average exposure over time and dietary frequency to calculate whether a product exceeds the MADL and requires a warning label. By contrast, Consumer

Reports assumes one serving a day of the product in its risk assessment calculations. This difference in methodology means no Prop 65 judgments can be made from CR's findings. Our results are meant to provide guidance on which products have comparatively higher levels of lead, not to identify the point at which lead exposure will have measurable harmful health effects or to assess compliance with California law.

For lead, we also compared our test results to the Food and Drug Administration's interim reference levels (IRL) for children and women of childbearing age. This is a less protective risk level than CR's level of concern.

None of the products reached CR's level of concern for cadmium at one serving a day, but several met or exceeded the level for lead. (See the percentage of CR's level of concern for lead supplied by each product [here](#).)

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CR tested these 27 cassava products for arsenic, cadmium, lead, and mercury. The products are listed in alphabetical order. The values for arsenic, cadmium, and lead are given in micrograms (mcg) for one serving of the product and in parts per billion (ppb). Mercury was not detected in any of the products.

Product	Serving Size	Total Arsenic (mcg) ¹	Total Arsenic (ppb) ¹	Cadmium (mcg)	Cadmium (ppb)	Lead (mcg)	Lead (ppb)
365 Whole Foods Market Sea Salt Cassava Tostones Cassava Chips ²	28 grams (5 chips)	ND	ND	0.48	17.3	8.6	308
Artisan Tropic Cassava Strips Sea Salt ³	30 grams (13 pieces)	ND	ND	2.24	74.6	3.1	105
Barnana Organic Cassava Chips Himalayan Pink Salt ³	28 grams (14 chips)	0.07	2.6	1.80	64.4	1.5	55.0
Bettergoods (Walmart) Finely Ground Cassava Flour Guacamole Flavored Tortilla Chips	28 grams (12 chips)	0.14	5.0	0.19	6.7	0.4	15.4
Bob's Red Mill Cassava Flour ³	35 grams (1/4 cup)	ND	ND	0.06	1.7	11.7	335
Carrington Farms Organic Cassava Flour ³	30 grams (1/4 cup)	0.20	6.5	0.05	1.8	3.1	104
Cult Crackers Crunchy Cassava Crackers ³	26 grams (6 crackers)	0.15	5.8	1.91	73.4	0.3	12.8
Goya Casabe Cassava Bread	75 grams (1 slice)	ND	ND	1.39	18.5	0.7	9.9
Goya Yuca Cassava Chips	28 grams (18 chips)	0.08	3.0	0.11	3.9	0.05	1.7
Heaven & Earth Cassava Chips	28 grams (15 chips)	ND	ND	0.40	14.2	0.5	18.3
Iberia Yuca Cassava Chips Lightly Salted	28 grams (1 ounce)	ND	ND	0.19	6.8	1.9	67.7
Jovial Organic Grain Free Cassava Spaghetti ³	57 grams (2 ounces)	ND	ND	0.15	2.6	6.0	105
La Fe Casabe Cassava Bread	85 grams (1 slice)	ND	ND	ND	ND	0.6	7.1
LesserEvil "No Cheese" Cheesiness Paleo Puffs ²	28 grams (25 puffs)	0.12	4.3	0.13	4.5	1.9	66.1

continued

ND = Not detected.

¹ Inorganic arsenic was not measured because total arsenic levels were not high enough to pose a health risk based on CR's risk assessment for a person 2 years or older consuming up to two servings per day.

² This product has been discontinued by the manufacturer, but consumers may still have this product in their pantries.

³ Carries a California Prop 65 warning label on the package or on the product website.

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Product	Serving Size	Total Arsenic (mcg) ¹	Total Arsenic (ppb) ¹	Cadmium (mcg)	Cadmium (ppb)	Lead (mcg)	Lead (ppb)
Lovebird Organic Grain Free Cereal Honey	30 grams (3/4 cup)	0.09	3.0	0.20	6.5	0.2	5.0
MadeGood Star Puffed Crackers Cheddar Flavor ⁴	30 grams (55 crackers)	0.17	5.7	0.24	8.1	1.0	31.7
Olipop Vintage Cola	12-ounce can	ND	ND	ND	ND	ND	ND
Otto's Naturals Grain-Free Ultimate Cookie Mix ³	29 grams (2 cookies)	ND	ND	0.07	2.3	2.1	72.5
Otto's Naturals Organic Multi-Purpose Cassava Flour ³	32 grams (1/4 cup)	0.07	2.2	0.09	2.7	11.6	363
Pamela's Organic Cassava Flour ^{2, 3}	30 grams (1/4 cup)	0.27	9.0	0.17	5.5	2.2	74.9
Quay Naturals Premium Cassava Flour ³	32 grams (1/4 cup)	ND	ND	ND	ND	8.9	278
Siete Grain Free Cookies Mexican Wedding	30 grams (5 cookies)	0.43	14.2	0.25	8.4	0.4	11.8
Simple Mills Fine Ground Sea Salt Almond Flour Crackers	30 grams (17 crackers)	0.24	8.0	2.63	87.8	0.1	3.9
Terrasoul Superfoods Cassava Flour ²	30 grams (1/4 cup)	0.41	13.8	0.09	3.1	5.3	176
Thrive Market Cassava Chips Sea Salt ⁵	28 grams (about 1 cup)	ND	ND	0.34	12.3	3.5	126
Tonomi Cassava Flour	32 grams (1/4 cup)	ND	ND	ND	ND	1.1	33.6
Unreal Dark Chocolate Coconut Bars	15 grams (1 bar)	0.08	5.1	0.58	38.5	0.2	10.8

⁴ The manufacturer said it reformulated this product in February 2025 and it no longer contains cassava; we purchased the products for our tests before the reformulation. Consumers may still have this product in their pantries.

⁵ The manufacturer originally told CR that based on its own testing, it had temporarily stopped selling this product while it conducted further tests. After publication, it said it had discontinued the product. Consumers may still have this product in their pantries.