Arsenic and Other Heavy Metals in Rice

GOALS

The goals of this project were to:

- Determine the levels of arsenic, inorganic arsenic, cadmium, lead, and mercury in popular brown and white rice varieties, including arborio, basmati, jasmine, parboiled, and sushi; quick-cook rices; and rice sides, as well as nonrice grains.
- Assess the health risks to children and adults from the dietary intake of these heavy metals from rice using the most health-protective limits.
- Evaluate the arsenic removal effectiveness of four rice cooking methods.

TEST APPROACH AND METHODS

We tested two or three unique samples of 39 rices, seven quick-cook rices, and six rice sides. In all, we tested 52 products and 142 samples. The models tested were purchased between July and September 2025 from multiple supermarkets and health food stores in New York, New Jersey, and Connecticut, as well as online.

We also tested 10 types of nonrice grains and seeds, including two or three unique samples from three to five brands of each type.

To be clear, Consumer Reports conducts its testing to provide consumers with advice to inform their decision-making. We do not perform compliance or regulatory testing, and our results are not meant to be viewed as such.

The samples were transferred into zip-top plastic bags, blind-coded to preserve their identities, and shipped to an independent, accredited laboratory.

At the laboratory, sample preparation or mixing was performed in fume hoods known to be free of trace metal contamination. Water, sample containers, and other materials used for the analyses were monitored for contamination to account for any biases in sample results.

Testing for total arsenic, cadmium, lead, and mercury used Triple Quadrupole Inductively Coupled Plasma Mass Spectrometry (ICP-QQQ-MS). All samples were prepared and analyzed in accordance with the Association of Official Analytical Chemists (AOAC) Method 2015.01.

All samples were analyzed for the inorganic arsenic species arsenate and arsenite, and three organic arsenic species—monomethyl arsonic acid (MMA), dimethyl arsinic acid (DMA), and trimethyl arsine oxide (TMAO)—using Ion Chromatography Inductively Coupled Plasma Mass Spectrometry (IC-ICP-MS).

Sample analysis was preceded by at least a five-point calibration curve spanning the entire concentration range of interest. Calibration curves were performed at the beginning of each analytical day and verified during analysis. The testing conformed to the quality control criteria and performance requirements set in cited official methods, as well as to those in ISO 17025.

DATA ANALYSIS AND RISK ASSESSMENT

We estimated daily rice consumption using the serving sizes on the product labels and associated daily intakes of metals from these estimates, our test results, and the average body weight of U.S. adults. We used the recommended body weight from the Environmental Protection Agency (2011 "Exposure Factors Handbook" [1]) of 70 kilograms (154 pounds).

For heavy metal test results below the method detection limit (MDL), we applied a method used by many risk assessors,[2] including the EPA,[3] to estimate the average concentration of a product. If the metal was detected in any of the two or three samples tested for a product, then test results below the MDL for that product were assumed to have a concentration equal to half the MDL. If the metal was not detected in any of the samples tested for a product, we assumed a concentration of zero for all the samples of that product.

Continued

[1] "Exposure Factors Handbook," 2011 Edition, chapter 8, *Environmental Protection Agency,* https://www.epa.gov/expobox/exposure-factors-handbook-2011-edition. [2] Xue, 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. [3] "Regional Guidance on Handling Chemical Concentration Data Near the Detection Limit in Risk Assessments," *Environmental Protection Agency,* https://www.epa.gov/risk/regional-guidance-handling-chemical-concentration-data-near-detection-limit-risk-assessments.

Arsenic in Rice *Continued*

Cancer Risk From Estimated Intakes of Inorganic Arsenic Using the EPA Model

To estimate adult cancer risk from estimated intake of inorganic arsenic, we used the following equations:

- Excess Cancer Risk = Lifetime Average Daily Dose x Cancer Slope Factor
- Lifetime Average Daily Dose = (Inorganic Arsenic Concentration (mg/kg) x Intake Rate (kg/day) x Exposure Factor)/Body Weight

We used a cancer slope factor (CSF) of 31.7 milligrams per kilogram of body weight per day, based on the combined incidence of bladder and lung cancer from inorganic arsenic (as derived in the EPA IRIS 2025 draft assessment of the arsenic CSF). For the lifetime average daily dose (LADD), we divided our inorganic arsenic intake by 1,000 (to convert micrograms to milligrams) and then multiplied by the appropriate exposure factor (e.g., for adult intakes, we multiplied our intakes by a factor of 1.0) to represent a daily exposure over a standard lifetime of 70 years. We set a risk tolerance level of about one case of cancer in 1,000 people to assess excess cancer risks.

We compared our estimated daily intakes of the metals with health-based limits in the table below using the following equation:

% CR Level of Concern = (Estimated Daily Intake/Health-Based Limit) x 100

This equation derives from the public health concept of hazard quotient and the following equation:

Hazard Quotient (HQ) = Estimated Dose/Reference Dose

A % CR Level of Concern greater than 100 or HQ greater than 1 indicates a comparatively higher health risk at this consumption level.

We used the California Office of Environmental Health Hazard Assessment (OEHHA) Maximum Allowable Dose Levels (MADL) as our benchmarks for CR's levels of concern for cadmium and lead. MADLs are levels established through California's Proposition (Prop) 65 law. CR uses these values because the standards are the most protective of health. A measured level greater than

Selected Health-Based Exposure Limits: Cancer Risks From Estimated Intakes of Inorganic Arsenic and Noncancer Risks From Estimated Intakes of Cadmium, Lead, and Methylmercury

Heavy Metal	Source	Endpoint and Basis for Limit	Value (Unit)
Inorganic Arsenic	EFSA (2023)	A reference point that corresponds to a 5% increase in incidence of skin cancer relative to the background, and that also covers lung cancer, bladder cancer, skin lesions, ischemic heart disease, chronic kidney disease, respiratory disease, spontaneous abortion, stillbirth, infant mortality, and neurodevelopmental effects	0.06 ug/kg bw/day
Cadmium	OEHHA (2017)	OEHHA Proposition 65 Maximum Allowable Dose Level (MADL) for Chemicals Causing Reproductive Toxicity (cadmium, oral exposure)	4.1 ug/day
Lead	OEHHA (2017)	OEHHA Proposition 65 Maximum Allowable Dose Level (MADL) for Chemicals Causing Reproductive Toxicity (total lead, oral exposure)	0.5 ug/day
Methylmercury	EPA (Updated 2001)	Noncancer oral reference dose based on developmental neuropsychological impairment	0.1 ug/kg-day

Continued

Arsenic in Rice *Continued*

100 percent of CR's level of concern indicates that consumption of that serving amount 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 the label-recommended daily serving 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 cadmium or lead, not to identify the point at which cadmium or lead exposure will have measurable harmful health effects, or to assess compliance with California law.

ARSENIC REMOVAL EFFECTIVENESS OF FOUR RICE COOKING METHODS

To evaluate the arsenic removal effectiveness of four rice cooking methods, we selected four rice samples based on high inorganic arsenic content, rice color, and grain type. We instructed the lab to prepare the four samples in triplicate according to the four methods described briefly below, and then analyze the resulting 48 samples for the same analytes. The inorganic arsenic results of the 48 cooked samples were compared with their results uncooked.

1. Unwashed and Absorption Cooking
Cook unwashed rice sample in tap water and a covered beaker using the manufacturer's recommended rice-to-water ratio until all the water is absorbed and the rice is cooked.

2. Washed and Absorption Cooking
Wash and agitate rice sample for 5 minutes using 1:4 rice-to-water ratio, discard the wash water, and cook the rice in fresh tap water in a covered beaker using the manufacturer's recommended rice-to-water ratio until all the water is absorbed and the rice is cooked.

3. Presoaked and Absorption Cooking
Soak rice sample for 30 minutes using 1:4 rice-to-water ratio, discard the water, and cook the rice in fresh tap water in a covered beaker using the manufacturer's recommended rice-to-water ratio until all the water is absorbed and the rice is cooked.

4. Parboiled and Absorption Cooking
Add rice sample to boiling water using 1:4 rice-to-water ratio and cook for 5 minutes, discard the water, and cook the rice in fresh tap water in a covered beaker using the manufacturer's recommended rice-to-water ratio until all the water is absorbed and the rice is cooked.

Heavy Metals in Rice

CR tested these 52 rices for arsenic, cadmium, lead, and mercury. The products are listed in alphabetical order within each category of rice (brown, white, rice in microwavable pouches, and rice side dishes). The values are given in micrograms (mcg) per serving and parts per billion (ppb) and the values are averages from two to three lots tested for each product. ND=Not detected.

Product	Serving Size	Test Results									
		Total Arsenic Per Serving (mcg)	Inorganic Arsenic Per Serving (mcg)	Total Arsenic (ppb)	Inorganic Arsenic (ppb)	Cadmium Per Serving (mcg)	Cadmium (ppb)	Lead Per Serving (mcg)	Lead (ppb)	Mercury Per Serving (mcg)	Mercury (ppb)
BROWN RICE											
365 Whole Foods Market Organic Long Grain Brown Rice	¼ cup dry	19.44	5.85	432	130	0.44	9.88	0.03	0.60	0.11	2.52
Ben's Original Whole Grain Brown Rice	¼ cup dry	7.35	4.83	163	107	0.66	14.8	ND	ND	0.17	3.77
Carolina Whole Grain Brown Rice	¼ cup dry	9.65	5.72	214	127	0.44	9.77	0.07	1.53	0.09	2.06
Good & Gather (Target) Long Grain Brown Rice	¼ cup dry	9.63	6.23	214	138	0.89	19.7	ND	ND	0.17	3.81
Goya Organics Long Grain Brown Rice	¼ cup dry	20.71	6.28	493	150	0.50	11.9	0.08	1.96	0.12	2.97
Great Value (Walmart) Natural Brown Long Grain Rice	¼ cup dry	10.55	5.30	234	118	0.33	7.30	0.07	1.19	0.09	1.93
Iberia Long Grain Brown Rice	¼ cup dry	9.11	5.57	217	133	0.73	17.3	0.15	3.53	0.11	2.60
Iberia Parboiled Brown Rice	¼ cup dry	6.73	4.24	150	94.3	0.87	19.3	0.06	1.36	0.07	1.61
Lotus Foods Organic Brown Basmati Rice	¼ cup dry	3.46	2.55	72.1	53	1.44	30.0	0.31	6.42	0.08	1.73
Lundberg Organic Short Grain Brown Rice	¼ cup dry	4.41	3.72	98	82.6	0.13	2.87	0.03	0.74	0.06	1.25
Mahatma Jasmine Brown Thai Fragrant Whole Grain Rice	¼ cup dry	7.92	6.98	176	155	0.53	11.8	0.07	1.59	0.08	1.88
Nishiki Premium Medium Grain Brown Rice	¼ cup dry	7.29	5.75	162	128	0.20	4.42	0.04	0.97	0.09	1.91
Roland Brown Basmati Rice	¼ cup dry	3.73	3.30	74.6	66	0.90	18.0	1.52	30.4	0.07	1.35
Wellsley Farms (BJ's) Organic Long Grain Brown Rice	¼ cup dry	13.54	5.16	282	107	0.29	6.01	ND	ND	0.10	2.10

Continued

Heavy Metals in Rice *Continued*

Product	Serving Size	Test Results									
		Total Arsenic Per Serving (mcg)	Inorganic Arsenic Per Serving (mcg)	Total Arsenic (ppb)	Inorganic Arsenic (ppb)	Cadmium Per Serving (mcg)	Cadmium (ppb)	Lead Per Serving (mcg)	Lead (ppb)	Mercury Per Serving (mcg)	Mercury (ppb)
WHITE RICE											
365 Whole Foods Market Enriched Medium Grain Calrose Rice (sushi)	¼ cup dry	3.72	2.67	82.8	59.2	0.11	2.50	ND	ND	0.04	0.86
365 Whole Foods Market Organic Thai Jasmine White Rice	¼ cup dry	5.40	3.18	120	70.7	0.35	7.74	0.05	1.03	0.16	3.55
Botan Calrose Rice (sushi)	¼ cup dry	4.50	2.94	100	65.3	0.23	5.17	ND	ND	0.07	1.63
Canilla (Goya) Enriched Extra Long Grain Rice	¼ cup dry	7.61	4.02	169	89.4	0.95	21.2	ND	ND	0.12	2.75
Carolina Enriched Extra Long Grain White Rice	¼ cup dry	7.22	3.61	160	80.3	0.55	12.19	ND	ND	0.09	1.97
Carolina Gold Extra Long Grain Parboiled Rice	¼ cup dry	7.70	4.87	171	108	0.71	15.8	0.04	0.96	0.13	2.96
Carolina Jasmine Enriched Thai Fragrant Long Grain Rice	¼ cup dry	4.95	4.01	110	89.2	0.45	9.93	0.03	0.71	0.07	1.62
Carolina Organic White Rice	¼ cup dry	19.46	2.55	433	56.8	0.39	8.77	ND	ND	0.1	2.24
Della Arborio White Rice	¼ cup dry	10.06	3.25	224	72.3	0.38	8.42	0.05	1.05	0.07	1.63
Della Basmati White Rice	¼ cup dry	6.12	3.58	136	79.5	0.56	12.5	0.03	0.72	0.17	3.68
Dynasty Jasmine Rice	¼ cup dry	5.28	3.24	117	72.0	0.26	5.86	ND	ND	0.14	3.05
Earthly Grains (Aldi) Long Grain White Rice	¼ cup dry	7.32	3.79	163	84.3	1.1	24.5	ND	ND	0.13	2.85
Good & Gather (Target) Enriched Long Grain White Rice	¼ cup dry	5.83	4.48	130	99.7	1.31	29.1	ND	ND	0.05	1.15
Goya Thai Jasmine Rice	¼ cup dry	5.38	3.54	108	70.7	0.34	6.78	0.05	0.94	0.08	1.64
Great Value (Walmart) Basmati Rice	¼ cup dry	2.49	1.99	55.4	44.3	0.46	10.3	0.04	0.89	0.04	0.81
Great Value (Walmart) Long Grain Enriched Rice	¼ cup dry	6.75	3.89	150	86.4	0.91	20.3	ND	ND	0.16	3.62

Continued

Heavy Metals in Rice *Continued*

Product	Serving Size	Test Results									
		Total Arsenic Per Serving (mcg)	Inorganic Arsenic Per Serving (mcg)	Total Arsenic (ppb)	Inorganic Arsenic (ppb)	Cadmium Per Serving (mcg)	Cadmium (ppb)	Lead Per Serving (mcg)	Lead (ppb)	Mercury Per Serving (mcg)	Mercury (ppb)
WHITE RICE *Continued*											
Great Value (Walmart) Thai Hom Mali Jasmine Rice	¼ cup dry	5.21	3.04	116	67.5	0.29	6.48	0.05	1.14	0.12	2.63
Iberia Enriched Extra Long Grain Rice	¼ cup dry	8.72	4.53	194	101	0.85	19.0	ND	ND	0.12	2.56
Kokuho Rose Rice (sushi)	¼ cup dry	4.61	3.11	103	69.2	0.12	2.77	ND	ND	0.03	0.67
Lundberg Organic Sushi White Rice	¼ cup dry	1.87	1.73	41.6	38.5	0.21	4.57	ND	ND	0.02	0.41
Lundberg Organic White Arborio Gourmet Rice	¼ cup dry	3.20	2.52	71.1	56.0	0.36	7.92	ND	ND	0.03	0.63
Mahatma Extra Long Enriched Rice	¼ cup dry	6.63	3.97	147	88.3	1.17	25.9	ND	ND	0.11	2.45
Nishiki Medium Grain Rice (sushi)	¼ cup dry	3.90	2.41	86.6	53.6	0.21	4.56	ND	ND	0.08	1.71
RiceSelect Organic Texmati White Rice	¼ cup dry	7.47	2.70	166	60.0	0.37	8.29	ND	ND	0.14	3.07
Royal Basmati Rice	¼ cup dry	1.67	1.46	37.1	32.4	0.32	7.22	ND	ND	0.03	0.67
RICE IN MICROWAVABLE POUCHES (white and brown)*											
365 Whole Foods Market 90 Second Organic Brown Basmati Rice	1 cup cooked	2.39	1.72	17.1	12.3	1.16	8.31	0.22	1.56	0.10	0.72
Ben's Original Ready Rice Long Grain White	1 cup cooked	6.65	5.11	47.5	36.5	0.61	4.37	0.79	5.61	0.12	0.84
Good & Gather (Target) 90 Second Original Long Grain White Rice	1 cup cooked	5.18	2.33	37.0	16.7	0.92	6.54	ND	ND	0.22	1.61
Great Value (Walmart) 90 Second Long Grain White Rice	1 cup cooked	7.58	5.18	54.2	37.0	0.47	3.37	0.09	0.64	0.12	0.88
Lundberg 90 Second Organic Jasmine Rice	1 cup cooked	4.37	1.44	29.5	9.71	0.35	2.35	ND	ND	0.19	1.28
Mahatma 90 Second Jasmine Rice	1 cup cooked	5.82	2.79	41.6	19.9	0.25	1.79	0.13	0.93	0.19	1.33
Seeds of Change 90 Second Organic Jasmine Rice (white)	1 cup cooked	9.33	5.97	62.2	39.8	0.37	2.43	ND	ND	0.23	1.53

Continued

Heavy Metals in Rice *Continued*

Product	Serving Size	Test Results									
		Total Arsenic Per Serving (mcg)	Inorganic Arsenic Per Serving (mcg)	Total Arsenic (ppb)	Inorganic Arsenic (ppb)	Cadmium Per Serving (mcg)	Cadmium (ppb)	Lead Per Serving (mcg)	Lead (ppb)	Mercury Per Serving (mcg)	Mercury (ppb)
RICE SIDE DISHES											
Ben's Original Long Grain & Wild Rice	¼ cup rice dry; 4 tsp. seasoning	9.34	6.88	222	167	1.28	57.2	1.89	112.3	0.18	5.43
Goya Spanish Style Yellow Rice	¼ cup seasoned rice dry	7.22	4.51	160	100	0.91	20.3	0.12	2.58	0.11	2.46
Lundberg Organic Cliantro Lime Rice	⅓ cup rice dry; 2 tsp. seasoning	5.37	3.44	263	105	0.97	24.6	0.7	104	0.35	7.10
Near East Rice Pilaf Spanish Rice	⅓ cup rice dry; 1 Tbsp. seasoning	9.57	6.57	200	144	1.27	73.4	0.83	46.7	0.16	3.66
Rice-A-Roni Cilantro Lime	¼ cup rice dry; 1 Tbsp. seasoning	9.69	6.79	180	127	0.92	30.1	0.48	19.4	0.14	2.87
Zatarain's Yellow Rice	⅓ cup seasoned rice dry	8.98	5.38	160	96.1	1.23	22	0.18	3.14	0.13	2.28

*These rices are precooked. We tested them directly from the package without microwaving them first.