

# Consumer Reports Test Methodology for Heavy Metals in Spices

## GOALS

- To build on CR’s 2021 testing, include spices not previously tested, and include those popular in cuisines from China, India, and elsewhere in the world.
- To investigate spices from local sources that were imported outside of major distributors.

CR tested 78 spice products (266 samples) for lead, with cinnamon representing the largest number of products. Because these types of products have shown measurable levels of arsenic, cadmium, and mercury in the past, we tested for those metals as well.

## TEST APPROACH AND METHODS

The following spice samples, all blinded, were sent to a certified laboratory 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:

- three samples from three different lots (defined by best-buy or expiration date) for 18 products
- three samples from two different lots for 28 different products
- three samples from one lot for 27 products
- one sample for four products as a spot check

We reviewed all the test results and quality control data provided by the contract lab for accuracy and clarity and checked for errors. Heavy metal exposures and potential risks were not determined for the four products with only one sample tested.

## DATA ANALYSIS

To estimate the average concentration of each heavy metal in a tested spice model, we applied a method used by many risk assessors,<sup>1</sup> including the Environmental Protection Agency.<sup>2</sup> If a heavy metal was detected (greater than the method

detection limit or MDL) in any of the samples tested of a given 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 a given 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.

## RISK ASSESSMENT

We estimated adult and child intake of the tested heavy metal from a serving of each product and, where appropriate and applicable, compared the intake estimates to the exposure limits in Table 1 below.

**TABLE 1 - Health-Based Exposure Limits Selected for Risk Assessments for Heavy Metals**

Chemical	EPA RfD ug/kg bw/d	OEHHA MADL ug/day	FDA IRL ug/day
Arsenic	0.1 <sup>3</sup>	N/A	N/A
Cadmium	NA	4.1 <sup>4</sup>	N/A
Lead	NA	0.5 <sup>5</sup>	2.2 <sup>6</sup> 8.8 <sup>7</sup>
Mercury	0.1 <sup>8</sup>	NA	

OEHHA = California Office of Environmental Health Hazard Assessment. MADL = Maximum allowable dose level.

FDA IRL = Food and Drug Administration Interim Reference Level.

Noncancer exposure risks were calculated by the Hazard Quotient Method<sup>9</sup> and the following equation:

HQ = Exposure Dose/Reference Dose (TABLE 1) *continued*

<sup>1</sup> 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): 345-35.

<sup>2</sup> Environmental Protection Agency. “Regional Guidance on Handling Chemical Concentration Data Near the Detection Limit in Risk Assessments,” <https://www.epa.gov/risk/regional-guidance-handling-chemical-concentration-data-near-detection-limit-risk-assessments>.

<sup>3</sup> [https://iris.epa.gov/static/pdfs/0278\\_summary.pdf](https://iris.epa.gov/static/pdfs/0278_summary.pdf).

<sup>4</sup> <https://oehha.ca.gov/chemicals/cadmium>.

<sup>5</sup> <https://oehha.ca.gov/proposition-65/chemicals/lead-and-lead-compounds>.

<sup>6</sup> <https://www.fda.gov/food/environmental-contaminants-food/lead-food-and-foodwares>. (See Interim Reference Level section for child IRL.)

<sup>7</sup> <https://www.fda.gov/food/environmental-contaminants-food/lead-food-and-foodwares>. (See Interim Reference Level section for female of child-bearing age IRL.)

<sup>8</sup> EPA has not established an oral reference dose (RfD) for total mercury, therefore the RfD for methylmercury is used to estimate risk, [https://cfpub.epa.gov/ncea/iris2/chemicallanding.cfm?substance\\_nmbr=73](https://cfpub.epa.gov/ncea/iris2/chemicallanding.cfm?substance_nmbr=73).

<sup>9</sup> “Risk Assessment for Other Effects,” <https://www.epa.gov/fera/risk-assessment-other-effects>.

We also expressed the estimated intake of each metal per serving as a percentage of the MADL and IRL. An HQ >1 or %MADL >100 would indicate that consumption of 1 serving per day would be of health concern.

**COMPARISON WITH NEW YORK STATE ACTION LEVELS**

Average results for arsenic, lead, and cadmium were compared with both current (1 ppm for inorganic arsenic, cadmium, and lead) and proposed New York State Class II Recall Action

Levels (0.210 ppm for inorganic arsenic and lead, and 0.260 ppm for cadmium).<sup>10</sup>

**LEAD IN CINNAMON RESULTS**

The chart below shows the amount of lead, in ppm, we found in each sample of each of the products we tested, including cinnamon powders and spice blends, such as 5-spice powder and garam masala, that contain cinnamon. Products are listed alphabetically by brand.

Brand	Spice Type	Sample Code	Lead (mg/kg or ppm)
365 Whole Foods Market	Ground Cinnamon	522	0.12
		522A	0.12
		522B	0.13
		<b>Average</b>	<b>0.12</b>
365 Whole Foods Market	Organic Ground Cinnamon	138	0.02
		383	0.02
		383A	0.02
		<b>Average</b>	<b>0.02</b>
Abido Spices	7 Mixed Spices	107	0.24
		475	0.22
		475B	0.23
		<b>Average</b>	<b>0.23</b>
Badia	Cinnamon Powder	353	1.13
		385	0.8
		430	1.16
		<b>Average</b>	<b>1.03</b>
BaiLiFeng	Five Spice Powder	347	1.16
		347A	1.14
		347B	1.15
		<b>Average</b>	<b>1.15</b>

<sup>10</sup> [https://www.google.com/url?q=https://agriculture.ny.gov/heavy-metals-spices&sa=D&source=docs&ust=1719599215123278&usg=AOvVaw3K6eWpwOJMbhZzX\\_7BTgWg](https://www.google.com/url?q=https://agriculture.ny.gov/heavy-metals-spices&sa=D&source=docs&ust=1719599215123278&usg=AOvVaw3K6eWpwOJMbhZzX_7BTgWg)

TABLE 2 - Cinnamon/Blends Extended Results <i>continued</i>			
Brand	Spice Type	Sample Code	Lead (mg/kg or ppm)
Bowl & Basket	Ground Cinnamon	564	0.62
		597	2.48
		597A	2.37
		<b>Average</b>	<b>1.82</b>
Deep	Cinnamon Powder	579	0.87
		579A	0.88
		632	1.29
		<b>Average</b>	<b>1.02</b>
EGN	Cinnamon Powder	305	2.92
		305A	2.85
		305B	2.96
		<b>Average</b>	<b>2.91</b>
Good & Gather	Ground Cinnamon	140	0.57
		349	0.55
		550	0.54
		<b>Average</b>	<b>0.56</b>
Great Value	Ground Cinnamon	144	0.78
		263	0.89
		320	0.71
		<b>Average</b>	<b>0.79</b>
Happy Belly	Ground Cinnamon	69	0.89
		069A	0.87
		162	0.83
		<b>Average</b>	<b>0.87</b>
Kirkland Signature	Organic Saigon Cinnamon	60	0.59
		401	0.9
		401A	0.91
		<b>Average</b>	<b>0.8</b>

TABLE 2 - Cinnamon/Blends Extended Results <i>continued</i>			
Brand	Spice Type	Sample Code	Lead (mg/kg or ppm)
Loisa	Organic Cinnamon	566	0.04
		566A	0.04
		566B	0.05
		<b>Average</b>	<b>0.04</b>
McCormick	Cinnamon	215	0.2
		442	0.1
		527	0.38
		<b>Average</b>	<b>0.23</b>
Mimi's Products	Ground Cinnamon	157	1.97
		343	2.16
		585	1.97
		<b>Average</b>	<b>2.03</b>
Morton & Bassett San Francisco	100% Organic Ground Cinnamon	356	0.04
		222A	0.04
		222B	0.04
		<b>Average</b>	<b>0.04</b>
Morton & Bassett San Francisco	Ground Cinnamon	181	0.55
		181A	0.56
		468	0.56
		<b>Average</b>	<b>0.55</b>
Natural Plus Green	Five Spices Powder	173	0.47
		173A	0.25
		173B	0.33
		<b>Average</b>	<b>0.35</b>
Paras	Cinnamon Powder	608	3.65
		608A	3.52
		608B	3.38
		<b>Average</b>	<b>3.52</b>

TABLE 2 - Cinnamon/Blends Extended Results <i>continued</i>			
Brand	Spice Type	Sample Code	Lead (mg/kg or ppm)
Penzeys	Ceylon Cinnamon	402	0.8
		112A	0.75
		112B	0.78
		<b>Average</b>	<b>0.78</b>
Penzeys	Ground Cinnamon	254	0.31
		536	0.41
		536A	0.39
		<b>Average</b>	<b>0.37</b>
Penzeys	Vietnamese Cinnamon	268	0.6
		333A	0.61
		333B	0.44
		<b>Average</b>	<b>0.55</b>
Rani Brand	Ground Cinnamon	299	1.4
		299A	1.23
		299B	1.55
		<b>Average</b>	<b>1.39</b>
Sadaf	Cinnamon Powder	91	0.03
		135	0.03
		135A	0.05
		<b>Average</b>	<b>0.04</b>
Sadaf	Seven Spice	80	0.16
		080A	0.14
		080B	0.14
		<b>Average</b>	<b>0.15</b>
Shan	Garam Masala Powder	284	0.3
		463	0.25
		600	0.27
		<b>Average</b>	<b>0.28</b>

TABLE 2 - Cinnamon/Blends Extended Results <i>continued</i>			
Brand	Spice Type	Sample Code	Lead (mg/kg or ppm)
Simply Organic	Cinnamon	133	0.34
		272	0.2
		699	0.31
		<b>Average</b>	<b>0.28</b>
Spicy King	Five Spices Powder	571	0.98
		571A	1.11
		571B	1.06
		<b>Average</b>	<b>1.05</b>
Swad	Garam Masala Powder	188	0.32
		370	0.4
		687	0.47
		<b>Average</b>	<b>0.4</b>
The Spice Lab	Organic Ground Cinnamon	467	0.77
		467A	0.73
		525	0.29
		<b>Average</b>	<b>0.6</b>
Three Rivers	Cinnamon Stick Powder	158	1.22
		158A	1.29
		158B	1.26
		<b>Average</b>	<b>1.26</b>
Trader Joe's	Organic Ground Cinnamon	207	0.37
		360	0.84
		360A	0.85
		<b>Average</b>	<b>0.69</b>
Wei-Chuan	Five Spice Powder	298	0.35
		298A	0.37
		298B	0.36
		<b>Average</b>	<b>0.36</b>

<b>TABLE 2 - Cinnamon/Blends Extended Results</b> <i>continued</i>			
<b>Brand</b>	<b>Spice Type</b>	<b>Sample Code</b>	<b>Lead (mg/kg or ppm)</b>
<b>Yu Yee Brand</b>	<b>Five Spice Powder</b>	626	1.29
		626A	1.18
		626B	1.27
		<b>Average</b>	<b>1.25</b>
<b>Zara Foods</b>	<b>Cinnamon Powder</b>	530	1.26
		530A	1.23
		530B	1.33
		<b>Average</b>	<b>1.27</b>
<b>Ziyad Brand</b>	<b>Premium Seven Spice Blend</b>	493	0.74
		493A	0.78
		493B	0.69
		<b>Average</b>	<b>0.73</b>