

DANDELION SMALL-BATCH CHOCOLATE

Cadmium and Lead (aka Heavy Metal Thunder)

Fun fact: Cadmium is a metal found in the Earth's crust; it naturally occurs in the soil as a result of volcanic emissions that have taken place over thousands of years. Plants pull compounds from the soil into their trunks, leaves, fruits, and seeds. Cadmium is no exception, and can be found in high concentrations in fruits and vegetables, particularly root vegetables, and leafy greens such as spinach and kale. Cereals, rice, nuts, pulses, soybeans, shellfish, organ meats, and other foods also have naturally high concentrations of cadmium.

But wait, what does this have to do with chocolate?

Cadmium and lead became a hot topic at the end of 2022, when a *Consumer Reports* article discussed cadmium and lead in chocolate — so we thought it was worth diving into some detail for the interested reader.

There are no U.S. federal regulations or guidelines on dietary exposure to cadmium. The sole U.S. regulation regarding cadmium and lead in chocolate, that we know of, is California's [Proposition 65](#). Prop 65 was created in 1986 as a way to give consumers recourse if businesses exposed them to dangerous compounds. *Prop 65 was designed as a right-to-know law, and not a determinant of safety.*

Hundreds of compounds are listed under Prop 65, and limits for each were set based on the **No Observable Effect Level** (NOEL) — as determined, per the California Office of Environmental Health Hazard Assessment (OEHHA), “based on the most sensitive study deemed to be of sufficient quality (22 CCR Section 12803(a)(4)).” The NOEL level (an amount that would cause no harm) was then divided by 1000. Alternatively, a study could indicate the **Lowest Observable Effect Level** (LOEL), and that number would be divided by 10, and then divided again by 1000. The resulting micro-quantities are considered a **Maximum Allowable Dose Level** (MADL). To be clear, *the MADL is either 1000 times below what is found to cause no harm, or 10,000 times lower than what is shown to cause harm.* Prop 65 does not state that anything beyond the MADL is dangerous — just that anything beyond the MADL requires a warning.

As a side note, while the vast majority of our products are under Prop 65 limits, we provide warning signs at our points of sale, both in person and online, to ensure that our guests are informed, and that we are compliant with California law.

Interestingly, Prop 65 provides an exemption for any compounds that are "naturally occurring" — that is, not potentially resulting from processing, or from metal packaging. This is why there are no warnings printed on foods such as **spring-mix salad** (which contains much higher levels of both cadmium and lead, per serving, than chocolate), or **sunflower seeds** (which have similarly high levels). Since these products are not “manufactured,” they fall under the exemption.

Over time, several organizations have tested various products using the Prop 65 guidelines, and based on what they've found, have initiated lawsuits. As You Sow is one such organization that focuses on chocolate. They tested bars from multiple makers, and detected differing levels of cadmium and lead. Their case against nine manufacturers was brought together in a [summary judgment](#) that decided three things:

1. A number of chocolate makers needed to pay settlement money to As You Sow (this is their income stream).
2. As You Sow was required to conduct and publish a study determining where and how cadmium and lead come to exist in chocolate, and whether the two metals are present in cocoa beans.
3. New, more practical limits were agreed upon for cadmium and lead levels in chocolate. The minimum lead and cadmium concentrations necessitating Prop 65 warnings are shown below, in parts per million (ppm):

Covered Product	Cadmium Concentration	Lead Concentration
Chocolate products with up to 65 percent cocoa content	0.40 ppm	0.10 ppm
Chocolate products with greater than 65 percent and up to 95 percent cocoa content	0.45 ppm	0.15 ppm
Chocolate products with greater than 95 percent cocoa content	0.96 ppm	0.225 ppm

The fact that chocolate can contain cadmium and lead has been in the news largely because As You Sow published their [report](#) in August of 2022. Their document outlines that cadmium is naturally occurring, coming into chocolate through the soil in which cacao trees grow; and that lead comes into cocoa beans via environmental exposure.

At Dandelion, we test for both microbiological contaminants and heavy metals in every new delivery of beans: We have a 10 percent representative lot sample drawn by an independent company and delivered to Anresco Laboratory in San Francisco, for testing. Currently we will

reject any beans that test positive for E. coli, salmonella, and/or listeria, and we monitor levels of cadmium, lead, arsenic, and mercury.

Additionally, we test all of our finished chocolate for cadmium and lead to ensure that levels are extremely low, and we compare our results to the levels set by the summary judgment. We've found traces of cadmium in nearly all of our chocolate, though the only bars that have shown levels requiring a Prop 65 warning are our bars made of beans from Ecuador. Ecuador tends to have higher soil levels of cadmium than other origins, but we don't want to abandon the country's cocoa farmers and producers, with whom we've worked for years; hence we warn consumers of the general risk.

As noted above, lead in cocoa is less well understood than cadmium, it's assumed to come from the environment. The highest level of lead we've ever found in our chocolate was 0.034 ppm, which is barely above the detection threshold, and an order of magnitude *below* the Prop 65 limit of 0.15 ppm (shown above). None of our bars contains significant levels of lead: Of the 17 bars we tested recently, 10 of them showed no lead at all, and the other seven were only slightly above the detection threshold of the test (around 0.01 ppm).

Origin	Harvest	Percentage	Cadmium (ppm)	Lead (ppm)
Ambanja, Madagascar	2017	70%	0.177	<i>none detected</i>
Ambanja, Madagascar	2019	70%	0.221	0.029
Camino Verde, Ecuador	2020	70%	0.619	<i>none detected</i>
Camino Verde, Ecuador	2022	70%	0.018	0.027
Camino Verde, Ecuador	2022	100%	0.9	0.034
Hacienda Azul, Costa Rica	2022	70%	<i>none detected</i>	<i>none detected</i>
Costa Esmeraldas, Ecuador	2020	70%	1.226	<i>none detected</i>
Costa Esmeraldas, Ecuador	2020	85%	1.561	<i>none detected</i>
Semuliki Forest, Uganda	2022	70%	0.323	0.016
Anamalai, India	2019	70%	0.057	0.02
Kokoa Kamili, Tanzania	2019	70%	0.016	0.016
Maya Mountain, Belize	2021	70%	0.261	<i>none detected</i>
Maya Mountain, Belize	2021	85%	0.45	<i>none detected</i>
Tumaco, Colombia	2021	70%	0.271	0.015
Tumaco, Colombia	2022	70%	0.264	<i>none detected</i>
Zorzal Comunitario, DR	2018	70%	0.155	<i>none detected</i>
Zorzal Comunitario, DR	2021	70%	0.167	<i>none detected</i>

We were curious about cadmium and lead levels in other foods, so we tested a wide variety from local grocery stores, and cadmium and lead was detected in almost all of them. This was by no means a scientific study, but we were curious how prevalent cadmium and lead are in general, and the answer is that there seem to be low levels of both metals just about everywhere.

Food	Cadmium (ppm)	Lead (ppm)
spring-mix salad	0.1	0.016
kale	0.076	<i>none detected</i>
tomato	<i>none detected</i>	<i>none detected</i>
carrot	0.011	0.011
sweet potato	<i>none detected</i>	0.015
organic brown mushrooms	<i>none detected</i>	0.013
extra-firm tofu	0.017	<i>none detected</i>
sunflower seeds	0.305	0.042
extra-long-grain white rice	0.015	0.014
organic brown jasmine rice	<i>none detected</i>	0.015
steel-cut instant oatmeal	0.054	0.011
fast-food fries	0.073	<i>none detected</i>

We believe it's always a good idea to understand the benefits and potential risks of foods that we eat. In assessing risks that any food might pose, we encourage you to consider your current health, as well as the food's source, and the quantity consumed. According to the [Centers for Disease Control](#), most orally ingested cadmium passes through the gastrointestinal tract unchanged, as most healthy individuals absorb only about 2.5 percent of cadmium ingested in food.

A European Union [study](#) on dietary exposure to cadmium found that grains and grain products cause the largest degree of exposure to cadmium (26.9 percent), followed by vegetables and vegetable products (16.0 percent), and starchy roots and tubers (13.2 percent). Chocolate and chocolate products accounted for only 4.3 percent of the dietary exposure to cadmium. It also found that often it's not foods with the highest cadmium levels, but foods consumed in larger quantities, that have the greatest impact on dietary exposure to cadmium.

If cadmium is of specific concern, we suggest avoiding our chocolate bars made from Ecuadorian cocoa, as chocolate produced from those beans tends to test higher for cadmium than other cocoa origins. When it comes to lead, based on the data, we believe that none of our chocolate is cause for concern.

We hope this information about cadmium and lead in general, as well as cadmium and lead in chocolate, proves useful. The natural world is fascinating and complex, and if you examine one small component, it can seem surprising; we find that the context around cadmium and lead in food has helped us understand our risk factors, and hope you feel the same!