

Air Toxics - Metals

Garden-Grown Food

The Oregon Health Authority (OHA) has received questions about gardening and eating foods grown within neighborhoods near emissions from commercial, industrial, and high traffic uses. This FAQ provides answers to questions and provides information to consider before testing garden-grown plants for metals. It also explains how to interpret plant test results, and what to compare plant test results to.

1- Why doesn't the state recommend to test, or test garden-grown foods?

Studies of garden plots in urban areas near emissions from industry and traffic show that the highest levels of metals are found within the actual garden soil (dirt). Very little is found on or in the plants themselves. There are several reasons for this:

- ❖ Similar to our outer layer of skin, plant leaves have an outer layer, called a cuticle. The cuticle provides a barrier that keeps some things in (like moisture), and other things out (like dirt, metals and other contaminants). Cuticle layers occur on all above-ground plant parts.
- ❖ Metals stick to soil (dirt). Even on Superfund site properties, the levels of contaminants found in garden-grown foods are much lower than those found in the soil. This is why soil testing is a better indicator of metals contamination.
- ❖ The state and federal governments do not regulate, or have health-based standards for metals in garden-grown food. This is also true for commercially grown foods (at the grocery store or otherwise). For all of these reasons it is most meaningful for the state to allocate resources to air and soil testing.

2- If I decide to test my garden-grown food, what should I know before I begin?

- ❖ **First test your soil.** Testing soil before testing plants is recommended, for the reasons listed above. Only if soil test results are above screening levels, do you have any reason to test garden-grown food.
- ❖ **Find a laboratory that can analyze plants in a way that will produce results that are meaningful to your health concerns.**

All analyses of plant tissues are conducted on a dry-weight basis, yet most plants are eaten fresh – as wet weight. Most fresh fruits and vegetables are far more than 50% water by weight, but any metals content does not change with the removal of water. Thus, the weight of the metals becomes a greater percentage of the dried fruit or vegetable and the concentration of contaminants found in your food is over-represented. When plant results are reported in dry weight an additional calculation

beyond the laboratory result must be done to represent the actual concentration of contaminants in wet weight.

Some metals are vital plant micro-nutrients. Many labs in Oregon that test soil for heavy metals can also test plant tissues for heavy metals. Ask before you submit any plant samples for analysis. Also see OHA's Healthy Gardening Factsheet and website for additional information.

❖ **Prepare plant tissue samples to produce meaningful results**

Before submitting a plant sample for analysis, wash your plants in the same way you normally would before eating them. The most meaningful test results are those that reflect what you would actually eat. For example, most people wash dirt off lettuce before preparing and eating a salad. Sending in plants straight from the garden without washing them will not accurately reflect the level of metals you would eat. Instead, it will capture additional metals in dust, dirt or soil particles on the outside of plants.

❖ **Have the laboratory test each plant separately**

If you are interested in knowing what metal concentration levels are found in your garden-grown food, send plants to the lab separately from one another. If you do not, you may get results for all of the plants you send, mixed together. For example, collect, wash, and send kale separately from parsley. Separate samples are more meaningful because they allow you to narrow in on the differences in the level of metals found between the plants. Also, results mean something very different if you tested an herb (something you eat less of) compared to a staple plant (something you eat more of).

❖ **How to request plant tissue testing with a lab**

Call your lab, and ask if they can do the following:

- Report the percent solids so that wet-weight can be calculated,
- Provide a separate analysis for each plant type,
- Test for the same metals that you tested in the soil testing that you had done prior to testing plants.

3- What do the test results mean?

Understanding the laboratory analysis results for garden-grown plants is challenging. Let's look at the example below. OHA reviewed the results of a laboratory analysis of kale sent in to DEQ. The kale was analyzed on a dry weight basis. If consumed fresh, kale is about 85% water. The 85% moisture content is just an average moisture content for kale; actual percentages can vary somewhat. The lab report didn't mention the percent solids (or percent moisture), so OHA was not able to do a conversion specific to this person's kale sample. The general formula below shows the basic conversion of dry weight to wet weight.

General formula:

Concentration of contaminant (wet weight) = Concentration of contaminant (dry weight) X percent solids

Your calculation:

$$\text{Amount in your garden-grown food} = \frac{\text{Laboratory result} \times \text{percent solids (found on the internet)}}{100}$$

It's important to remember that only a small fraction of heavy metals found within garden-grown food can actually be absorbed into your body when swallowed. This concept is called 'bioavailability'. Many heavy metals bind tightly to components of the plant or soil and just pass through our systems unchanged. The majority are not absorbed and do not remain in our bodies.

4- How do my results compare to grocery store food?

The United States does not have contaminant-based standards for garden-grown, or commercially grown food. The Oregon Health Authority refers to the World Health Organization international food trade standards to protect the health of consumers listed in the Codex Alimentarius (The Codex) as a comparison value for contaminants in fresh foods. Another resource is looking at average levels of metals found in our commercial food supply, through the U. S. Food and Drug Administration (FDA) Total Diet Study (TDS).

- ❖ **The Codex** - has established maximum levels (MLs), or guideline levels, for contaminants and naturally occurring toxins in food and feed, including MLs for some heavy metal concentrations in vegetables. It is important to note that the MLs were not developed based on the bioavailability of heavy metals in food. Research shows that specific nutrients in foods (for example, iron, vitamin C, calcium and phosphate) reduce the bioavailability of metals when eaten together. CODEX MLs reflect the maximum potential health risk of consuming contaminated vegetables.
- ❖ **The U.S. FDA TDS** - also known as the "market-basket survey"
<http://www.fda.gov/Food/FoodScienceResearch/TotalDietStudy/>
This study measures levels of certain chemical contaminants and nutrients in retail purchased foods. The study reports average levels for specific metals found, in specific food crops, prepared in a specific way. The most recent data from the FDA TDS include findings from foods collected from 2006 to 2011. The study analyzes foods as they would be eaten ("table ready"). In conducting the TDS research, the FDA collects food samples in cities throughout the country, buying foods from grocery stores and restaurants. The TDS includes levels of arsenic, cadmium, lead, and mercury.

Knowledge of the levels of contaminants in commercial foods is relevant because it provides context for the findings of contaminants found in garden-grown plants and the uncertainty most gardeners will face when it comes to the exact levels of contaminants within foods grown in a garden.

5- What are the ways that I can keep my garden-grown food safe to eat?

Garden-grown plants do not absorb metals from the air. There are many factors that can influence a plant's ability to absorb heavy metals through its roots: the type of plant, soil properties, climate and plant management practices all play a part. The use of clean garden soil, compost and organic matter (amendments) can help to lower the ability for plants to take up

contaminants at levels that are harmful to health. Keeping garden soil at a neutral pH by applying lime (calcium carbonate) will keep metals bound more tightly to soil and less available to plants. Mulching bare areas in the garden to reduce dust during the dry season will reduce dust blowing onto plants. Washing and peeling garden produce removes soil and other contaminants that can settle on plants.

6- How do I protect myself and my garden?

- ❖ **To protect yourself from air emissions that settle onto the surface of plants**
 - Wash, soak and peel garden-grown plants before eating them.
 - *Optional* (in cases with high concern and known soil contamination from air emissions) bring in clean soil and cover your garden bed with plastic or glass to create hoop houses, or cloche gardens.
- ❖ **To prevent air emissions of metals from settling on soil**
 - Add clean garden soil, compost on a regular basis.
 - Apply agricultural lime to maintain a neutral soil pH.
 - Cover bare ground with mulch, a cover crop, or rock to minimize dust.
 - Build raised garden beds using clean garden soil (avoid treated wood or railroad ties).
 - *Optional* (in cases with high concern and known soil contamination from air emissions) bring in clean soil and cover your garden bed with plastic or glass to create hoop houses, or cloche gardens.
- ❖ **Do not eat soil or dirt**
 - 1- Wash, soak or peel plants to avoid eating dust and soil particles.
 - 2- Water plants near the bottom of the plants, to prevent soil from splashing up onto plants. Avoid overhead watering.
 - 3- Take off shoes and wipe down pets to avoid tracking soil into your home.
 - 4- Wash your hands.
 - 5- Eat a diet rich in fresh fruits and vegetables, from a variety of sources. Eating a variety of fresh fruits and vegetables protects the body from absorbing metals and helps with many other chronic health conditions. Review OHA's fact sheet on Air Toxics-Metals and the "Protective benefits of eating a diet rich in calcium, iron, vitamin C and other micronutrients".

For additional guidance, reference OHA's [Healthy Gardening Factsheet](#) and [website](#).