

Lead and Arsenic in United States Spices

Sheneice Moore, Hannah Stoner, PhD, Tewodros Rango Godebo, PhD
LSU Health Sciences Center, New Orleans,
Environmental Health, Climate, and Sustainability

Background

For most cuisines around the world, spices are a critical ingredient for achieving specific flavors and vibrant colors. What most people don't know is that some of the spices are filled with toxic heavy metals. Toxic heavy metals such as Arsenic (As) and Lead (Pb) play a role in the declining health of the human body. Chronic exposure to As and Pb can accumulate in the body, causing potential health risks. These health risks can range from affected brain development and lower IQs in children; to reproductive problems, hypertension, and can even damage the kidneys and immune system functions in adults. Currently, there are no federal regulations regarding As and Pb in spices. U.S. federal limits for food are limited to infant rice cereal (As) and candy (Pb). Recently, the state of New York has implemented a maximum level (ML) of 210 mg/kg of both As and Pb in spices, requiring anything over to be recalled and reported to the state's department of health. There is also guidance by the Food and Agriculture Organization of the United Nations (FAO) with a ML of 500 µg/kg of As in salt and a range of 600-3000 µg/kg for other specific spices. This regulatory gap highlights the need for systematic evaluation of As and Pb contamination in spices commonly consumed in the United States to inform future public health policy.

Sample Area

Samples were gathered from local retail grocery stores; Whole Foods, Wal-Mart, and Rouses in New Orleans. These samples included a range of brands and prices.

Objectives

- To determine the concentrations of toxic elements Lead (Pb) and Arsenic (As) in spices
- To compare determined concentrations of Pb and As with reference levels established by the New York Department of Health (NYDOH) and the Food and Agriculture Organization of the United Nations (FAO)

Methods

A total of 28 spice samples were purchased from local retail grocery stores in New Orleans, LA. Each sample was weighed and digested with strong acids, and metals were analyzed using Inductively Coupled Plasma Mass Spectrometry (ICPMS). The results were then compared with standards set by the NYDOH and FAO Table 1. Statistical analysis was conducted on GraphPad Prism 11.0

Results

Elements		Percentiles					
n=28	Min-Max	5 th	25 th	Median	75 th	95 th	Mean ± SD
As	0.3-410	2.2	32	85	154	396	107±105
Pb	0.01-2550	0.86	84	222	419	1870	368±506

Table 1. Overall distribution of As and Pb in spices in µg/kg

Element (in µg/kg)	Standards	
	NYDOH	FAO
As	210	500
Pb	210	600-3000

Table 2. Comparison of As and Pb standards in spice samples.

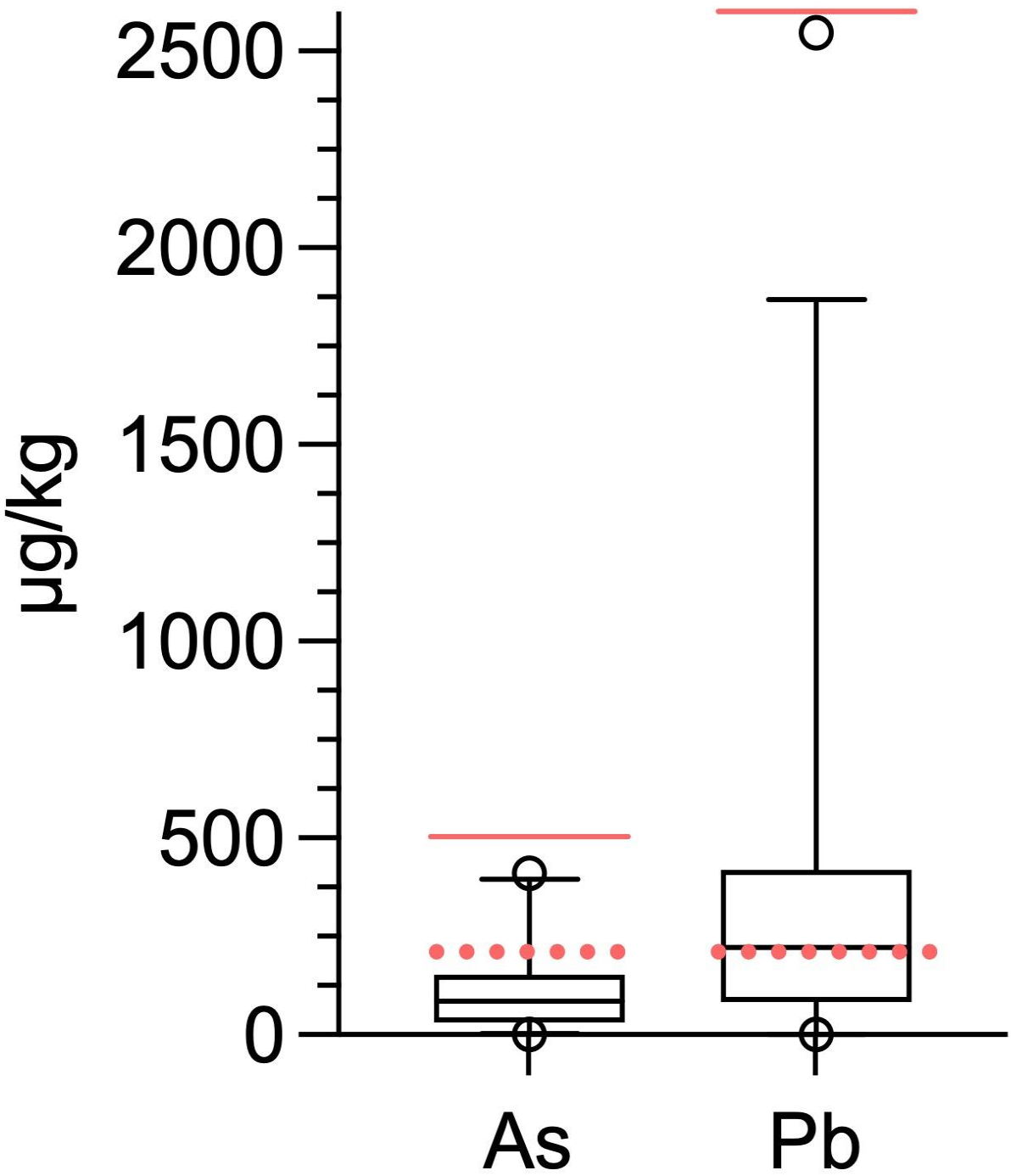


Figure 1. Box and Whicker Plots (Mean 5th-95th percentile, min-max) of As and Pb standards in spices. Thresholds: NYDOH indicated by the dotted line. FAO indicated by the solid line.

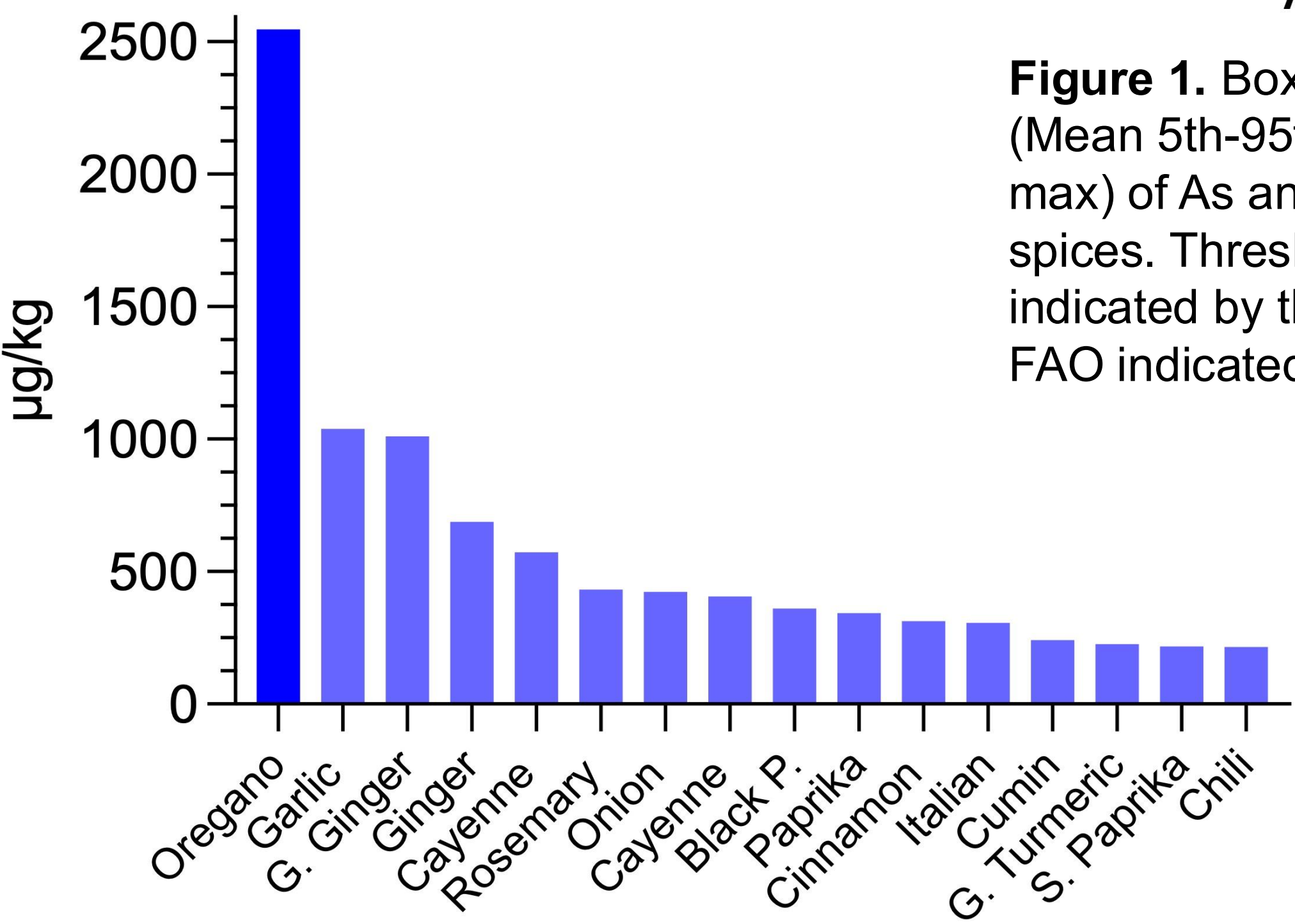


Figure 2. Samples Exceeding NYDOH threshold for Pb.

- Arsenic and Pb were found in all samples (Table 1).
- Cayenne pepper had the highest amount of As at 410 µg/kg.
- Oregano had the highest amount of Pb at 2550 µg/kg.
- Nutmeg had the lowest amount of Pb (0.3 µg/kg) and As (0.01 µg/kg),
- An oregano sample exceeded the Pb FAO standards. None exceeded for As.
- Two samples (cayenne pepper and oregano) exceeded the As standard set by NYDOH. and 16 samples exceeded for Pb (Figure 2).
- Spices that were made from leaves had the highest concentrations of both Pb and As (Table 3, Figure 3).

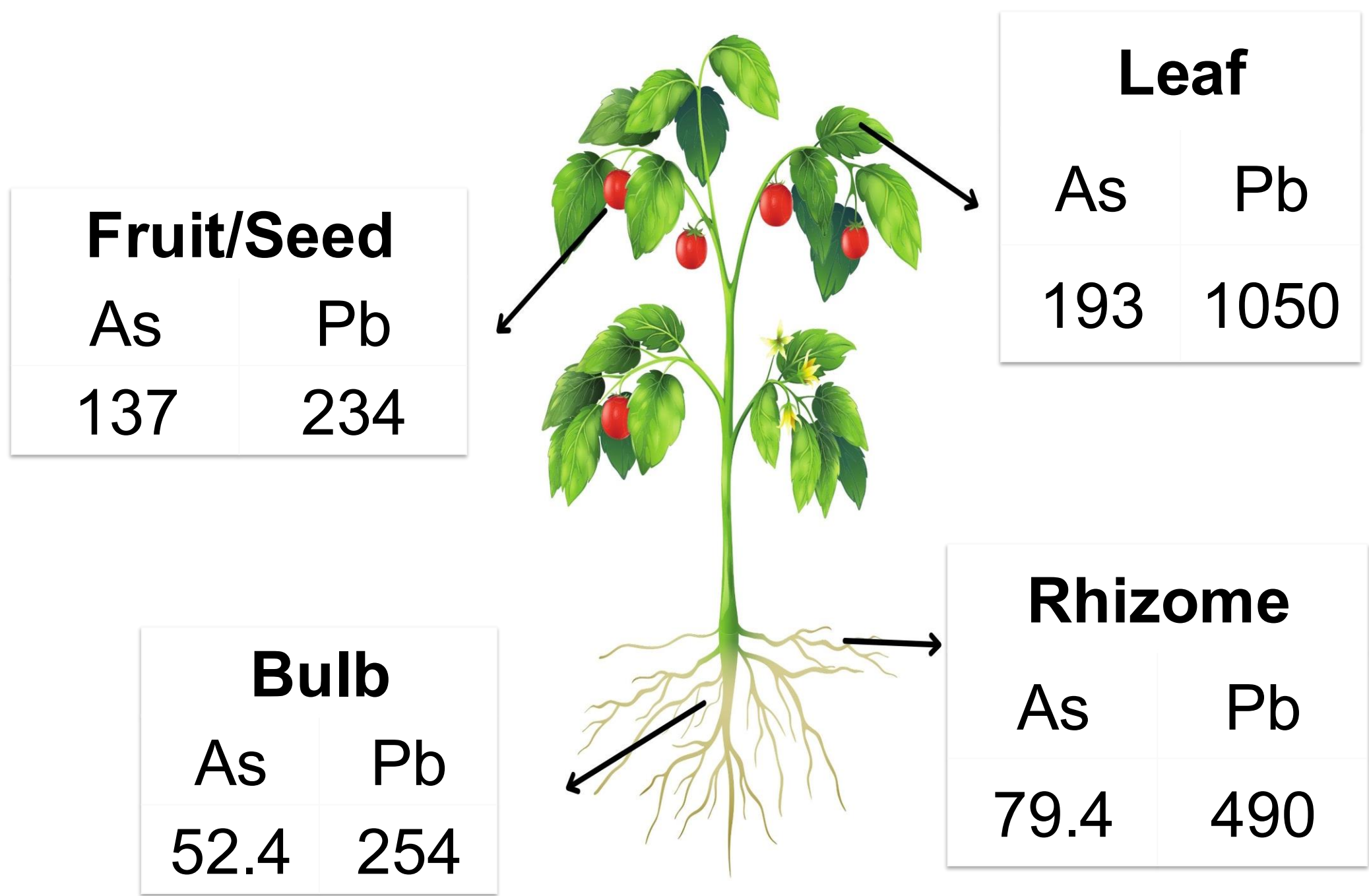


Figure 3. Average concentration of Pb and As by plant part.

Plant Part	Spices
Fruits/Seed	Cayenne Pepper, Paprika, Cumin, Black Pepper, Coriander, Mustard Powder, Nutmeg
Leaf	Oregano, Rosemary, Basil, Italian Seasoning
Bulb	Garlic, Onion
Rhizome	Ginger, Turmeric
Bark	Cinnamon

Table 3. Spice samples and their respective plant parts.

References

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