The Expert Voice of the U.S. Spice Industry in the Global Market

# Mitigating Heavy Metals in Spices: A Case Study of Food Ingredient Challenges and Solutions

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# About ASTA

**Vision:** *Ensure the supply of pure, safe spices, and shape public policy to advance the global industry*

ASTA was founded in 1907 following passage of the Pure Food and Drug Act to ensure member companies had resources and information to comply with new regulations - focus remains much the same today

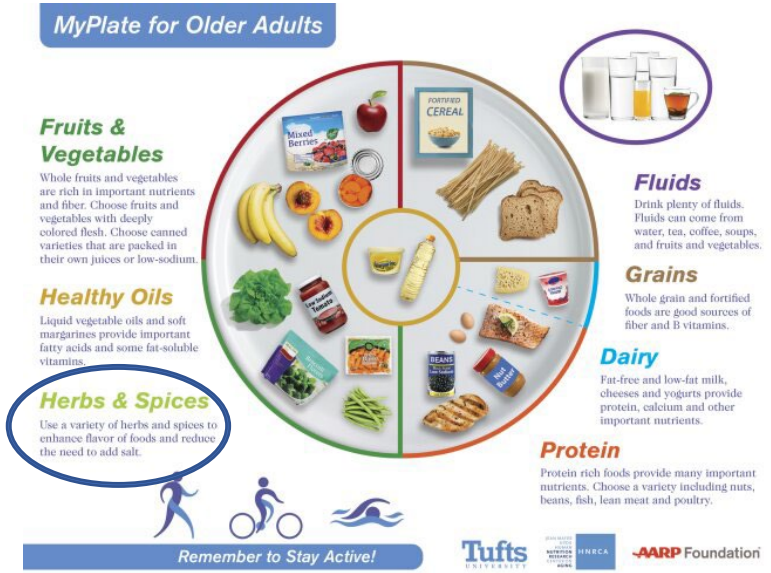
We have about 200 member companies involved in all aspects of spice industry

# Agenda

- Safety Considerations
- Trace Levels of Naturally-Occurring Heavy Metals in Spices
- Global Regulatory Limits
- Strategies to Mitigate Naturally-Occurring Levels
- Risk of Adulteration
- Research into Future Solutions

# Spice Safety & Exposure Considerations

- Spices are generally considered to be safe & healthy by regulatory authorities
  - Spices are consumed in very small quantities – a fraction of a gram per day
  - Levels observed vary, but vast majority <1ppm in U.S. according to published literature



# Spice Consumption as % of Total Diet

| | | Per Capita Mean Consumption Estimates* | |
|---|---|---|---|
| **Population subgroup** | **Diet component** | **- - - - g/day - - - -** | **g/kg-bw/day** |
| Children 1-6 y | Total diet | 1674 | 103 |
| Children 7-12 y | Total diet | 2037 | 56 |
| WCBA 14-49 y | Total diet | 2963 | 42 |
| | | | |
| Children 1-6 y | All spices | 0.02 | 0.001 |
| Children 7-12 y | All spices | 0.04 | 0.001 |
| WCBA 14-49 y | All spices | 0.06 | 0.001 |
| | | | |
| Children 1-6 y | % spices of total diet | 0.001% | 0.001% |
| Children 7-12 y | % spices of total diet | 0.002% | 0.002% |
| WCBA 14-49 y | % spices of total diet | 0.002% | 0.002% |

*Two-day average consumption estimates based on U.S. EPA's What We Eat in America - Food Commodity Intake Database, 2005-2010 (WWEIA-FCID 2005-10).
G: grams; kg-bw: kilogram bodyweight; WCBA: women of child bearing age; y: years

# Safety of Spice Consumption in Context of the Updated FDA IRL

| Population subgroup | Per user estimated exposure to lead from spice consumption* at 1 ppm (µg/day) | | % of FDA IRL** | |
|---|---|---|---|---|
| | Mean | 90th Percentile | Mean | 90th Percentile |
| Children 1-6 y | 0.05 | 0.15 | 2% | 7% |
| Children 7-12 y | 0.08 | 0.21 | 4% | 10% |
| WCBA 14-49 y | 0.16 | 0.46 | 2% | 5% |

*Two-day average consumption estimates based on U.S. EPA's What We Eat in America - Food Commodity Intake Database, 2005-2010 (WWEIA-FCID 2005-10).

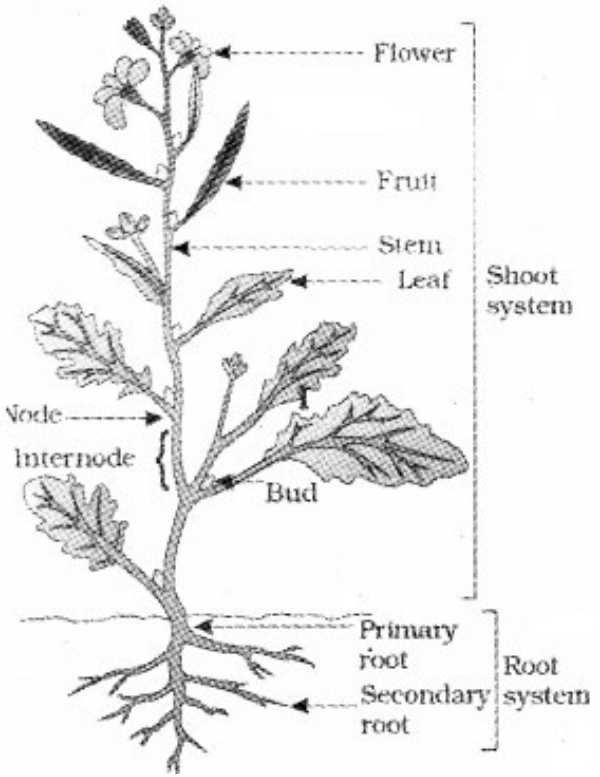
**FDA IRL is currently 2.2 µg/day for children and 8.8 µg/day for adults (including WCBA).

µg: micrograms; kg-bw: kilogram bodyweight; WCBA: women of child bearing age; y: years

# Why can Trace Levels of Heavy Metals Occur in Spices Naturally?

- As with any food product, the concentration of heavy metals in spices naturally varies due to where and how spices are grown, environmental factors, and soil conditions
- Spices come from dozens of crops grown in many different countries around the world and are sourced from different parts of the plant, including the roots, seeds, bark, fruit, or leaves

| Part of Plant | Spice |
|---|---|
| **Bark** | Cinnamon |
| **Berry** | Allspice, juniper, pepper (black, white, green, pink) |
| **Bud** | Cloves |
| **Flower** | Chamomile, lavender |
| **Fruit** | Anise (star), capsicums, cardamom, paprika, vanilla |
| **Leaf** | Balm (lemon), Basil leaf (sweet), Bay leaves, chervil, chives, cilantro, dill weed, marjoram, oregano, parsley, peppermint, rosemary, sage, savory, spearmint, tarragon, thyme |
| **Root** | Galangal, ginger, horseradish, turmeric |
| **Seed** | Anise seed, caraway seed, celery seed, coriander, cumin seed, dill seed, fennel seed, fenugreek seed, mustard seed, nutmeg, poppy seed, sesame |



# Naturally-Occurring Levels Vary by Part of the Plant and Dehydration Level

**Summary of background levels of lead in spices (Source: Codex 2022)**

| Food | Samples (N+ / N)[1] | Mean (mg/kg) | Median (mg/kg) | 95th percentile (mg/kg) |
|---|---|---|---|---|
| Culinary herbs (fresh) | 1,111/1,452 | 0.07 | 0.03 | 0.23 |
| Culinary herbs (dried) | 757/1,012 | 0.5 | 0.14 | 1.65 |
| Aril spices | 13/15 | 0.26 | 0.21 | 0.70 |
| Floral parts (flower, stigma, bud) | 43/59 | 0.34 | 0.11 | 1.14 |
| Fruits and berries | 1,954/2,546 | 0.23 | 0.11 | 0.57 |
| Rhizomes, bulbs and root | 502/550 | 2.04 | 0.12 | 1.92 |
| Bark | 402/448 | 0.67 | 0.26 | 2.48 |
| Dried seeds | 625/860 | 0.22 | 0.12 | 0.76 |

Fresh vs dried (loss of moisture concentrates)

Part of the plant has a significant impact on levels

# Global Regulatory Levels

- Because heavy metals occur naturally in spices, global regulatory authorities have considered heavy metal limits for spices that are based on natural occurrence, environmental considerations, production, and consumption patterns.
- A number of global regulatory authorities, most notably the European Commission, have established limits for lead in spices that are supported by available scientific evidence and enable access to a safe and reliable supply of spices for consumers. We strongly support the EU approach.
- Likewise, a similar approach is under consideration by the World Health Organization's Codex Committee on Contaminants in Food.
- Importantly, these standards avoid a one-size-fits-all approach and, instead, differentiate by spice type and element.

## EU Commission Lead Levels (2021)

| Category | Level (mg/kg) |
|---|---|
| Fruit spices | 0.6 |
| Root and rhizome spices | 1.5 |
| Bark spices | 2 |
| Bud spices and flower pistal spices | 1 |
| Seed spices | 0.9 |

## Proposed Codex Lead Levels (2021)

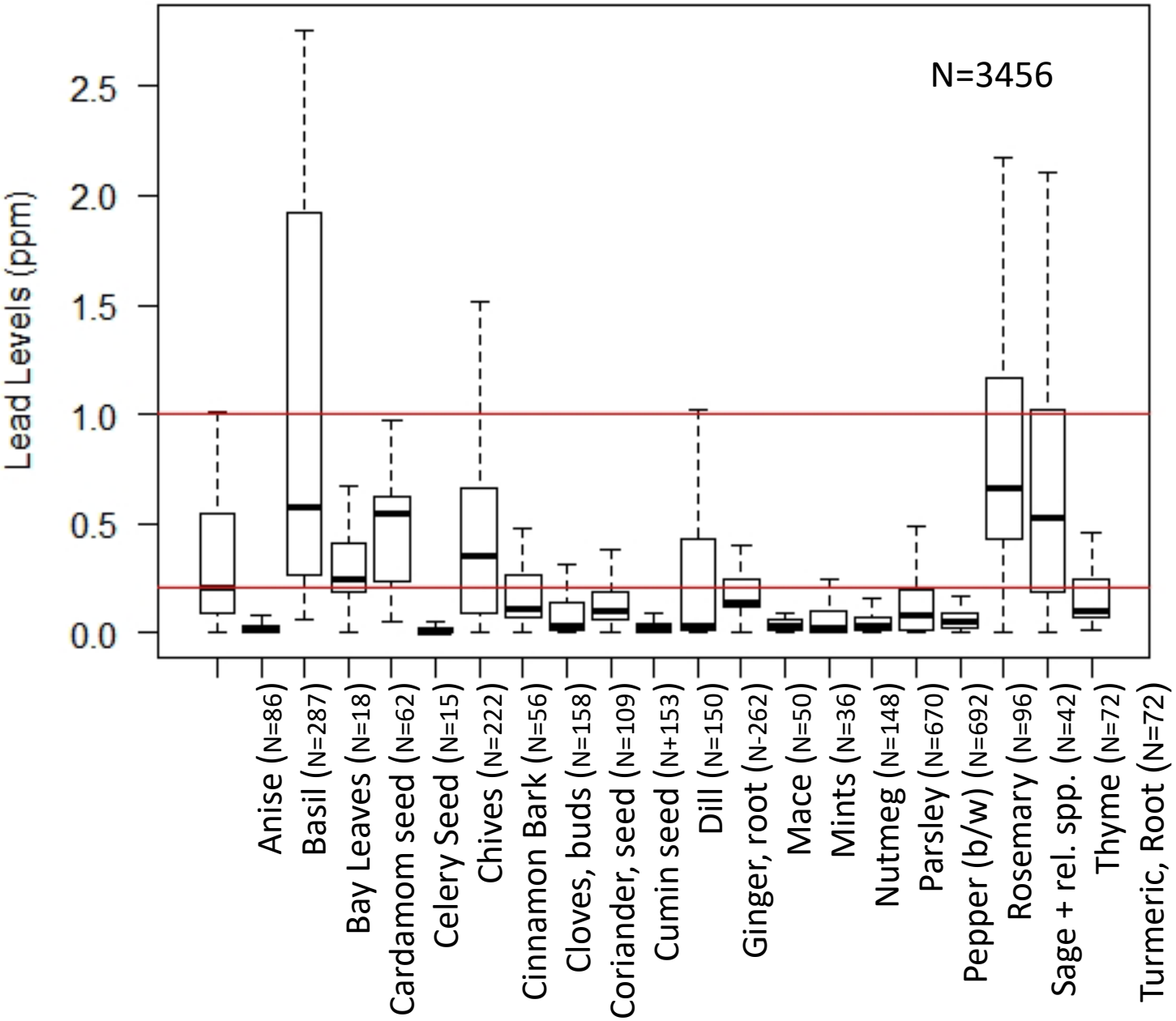
| Category | Level (mg/kg) |
|---|---|
| Culinary herbs (dried leaves or mixed herbs) | 2 |
| Dried bulbs, rhizomes, root spices | 2 |
| Bark | 2 |
| Dried fruits and berries spices | 0.6 |
| Dried seeds spices | 0.6 |
| Dried floral parts spices | 0.7 |

# New York State Proposed Action Levels

| Analyte | Class II Recall Action Level (ppm) |
|---|---|
| Lead (Pb) | >0.21 |
| Cadmium (Cd) | >0.26 |
| Inorganic Arsenic (As) | >0.21 |

**Up to 10 times lower than other global levels**

# Distribution of Lead Levels Among Spices (WHO GEMS, 2020)




**1.0 ppm**

**0.21 ppm**

3900+ data points available on 31 spices and herbs for 2020.

Figure represents the top 20 spices in the database for the US market.

# New York Limits on Hold While Additional Research is Conducted

NEW YORK STATE OF OPPORTUNITY. | Agriculture and Markets

**Input and Feedback Request**

**Who?** The New York State Department of Agriculture and Markets (AGM) welcomes feedback from stakeholders in the spices supply chain, regarding the areas listed below that pertain to AGM's proposed action level of lead in spices[1]. Comments will be accepted before 5:00 PM on November 25, 2022.

# Spice Industry Strategies to Mitigate Naturally-Occurring Heavy Metals

- **Farmer training on Good Agriculture Practices** – suppliers are trained in growing, harvesting, and storage techniques that are known to minimize heavy metal uptake from the environment.
- **Adherence to Good Manufacturing Practices** - Manufacturers use cleaning practices to minimize contributions from soil and the environment and adhere to practices to prevent the contribution of any heavy metals through processing.
- **Monitoring and Compliance -** Specifications and testing on heavy metals to ensure compliance with strict internal quality standards.

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# Good Agricultural Practices Guide (GAP Guide)

The original Good Agricultural Practices Guide was developed as a joint project by members of the International Organisation of Spice Trade Associations (IOSTA). The ASTA Guide is based on that document, updated in 2016 to reflect U.S. regulations and issues specific to exporting to the U.S. Use of this GAP Guide will assist those in the spice supply chain in understanding their responsibilities to provide clean, safe spice to consumers.

ASTA Good Agricultural Practices Guide – English Version 2016

IOSTA Good Agricultural Practices Guide – French

IOSTA Good Agricultural Practices Guide – Spanish

IOSTA Good Agricultural Practices Guide – Vietnamese

Search

Search...

Food Safety

- Clean, Safe, Spices Guidance Document
- Microscopic Identification of Spices
- Allergens
- Identification and Prevention of Adulteration Guidance Docume
- Validation Studies
- HACCP Guide to Spices and Seasonings
- Adulteration and Food Fraud
- White Papers
- Analytical Methods Manual
- Cleanliness Specifications
- Microbiology
- Spice Monographs
- Check Sample Program

Good Agricultural Practices Guidance documents are available for free on ASTA website in multiple languages!

# ASTA Heavy Metal Guidance Levels

ASTA has adopted guidance levels for lead in spices based on global regulatory limits, such as those in the EU and proposed by Codex

*Industry guidance levels for lead in spices and dried herbs.*

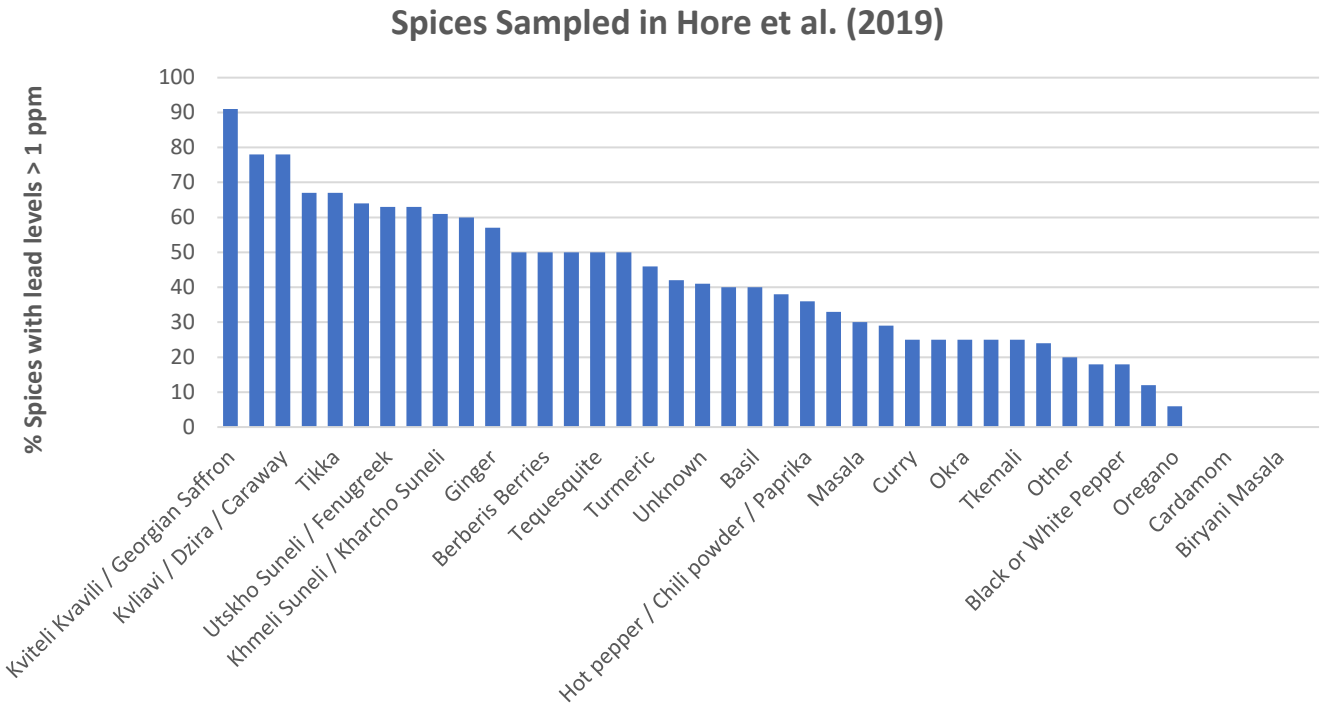
| Type of Spice (Dried) | Level (ppm) |
|---|---|
| Fruit spices | 0.6 |
| Seed spices | 0.9 |
| Bud spices | 1.0 |
| Flower pistil spices | 1.0 |
| Root and rhizome spices | 1.50 |
| Bark spices | 2.0 |
| Herbs | 2.0-2.5 |

# Levels in U.S. vs. Global Market

- Literature shows that average lead levels in American homes are significantly higher in spices purchased outside of the U.S. (especially in countries that have limited laboratory testing surveillance programs)
  - Hore et al. (2019) - Spices purchased abroad were 3x more likely to exceed a ref level of 2 ppm than spices purchased domestically (45% versus 13%, respectively)
  - Forsyth et al. (2019) - turmeric sold in local Bangladeshi markets had higher lead levels due to EMA with lead chromate than product exported to foreign markets.


# “A Spoonful of Lead”

A Spoonful of Lead: A 10-Year Look at Spices as a Potential Source of Lead Exposure




Only 21% of US spices exceeded 1 ppm compared to 66% of foreign samples

# Fraudulent Practices

- Known incidents of fraud involving use of lead chromate as colorant have resulted in very high levels in spices – up to 48,000ppm in the literature
- This is a distinct and separate problem from the naturally-occurring environmental levels and may present a safety concern
- As such, EU and U.S. regulatory action has focused on combating fraudulent adulteration of spices and industry implements

# Example – Lead Chromate in Turmeric in Bengali

- High levels of lead found in Bengali turmeric up to 1152 ppm
- Evidence of adulteration with lead chromate
- Contaminated spices sold domestically in Bengali, not exported to other regions
- ASTA working with researchers on prevention methods

MEDICAL

Stanford study describes spice makers adding lead to turmeric

By Nick Lavars
September 24, 2019

VIEW 1 IMAGE

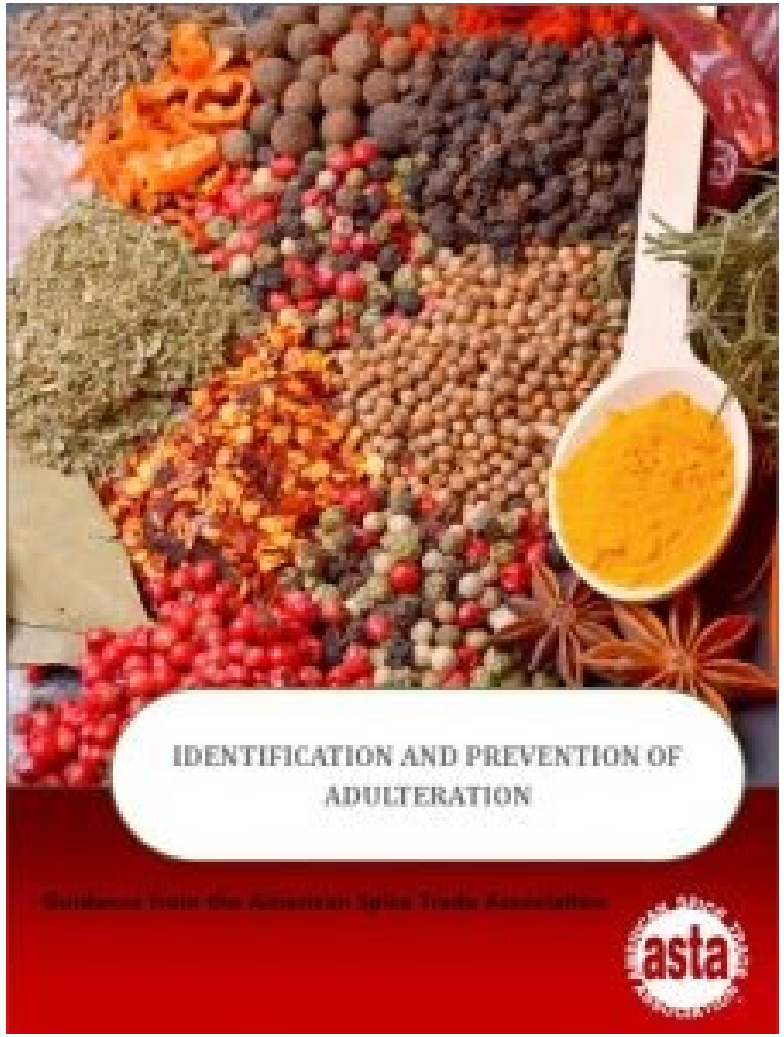
*A new study has found that some spice makers in Bangladesh are using lead as part of their turmeric production* 5PH/Depositphotos

Environmental Research

Turmeric means "yellow" in Bengali: Lead chromate pigments added to turmeric threaten public health across Bangladesh

# Mitigation Strategies for Prevention of Adulteration

- Risk Assessment
  - Understanding vulnerabilities
  - Product type
  - History
- Supply chain controls
  - Sampling
  - Audits
  - Testing




AMERICAN SPICE TRADE ASSOCIATION asta




# Collaboration, Partnerships, & Research at Origin

# Research at Origin – Vietnamese Cassia

Regional variation

Driven by soil concentrations

Mitigation opportunities

# Research at Origin – Mediterranean Herbs

Oregano

Sage

Thyme

# In Conclusion

- Naturally-occurring levels in spices vary by type of spice and environmental factors, but are typically safe since spices are consumed in small quantities
- ASTA supports limits that are science-based and harmonized with global regulations
- Spices purchased overseas have higher levels of lead due to lack of governmental and industry controls and in some cases, potential for fraudulent practices
- The spice industry uses good agricultural practices and testing to ensure safety and compliance – and additional research is being done to identify new strategies to reduce levels