

Heavy Metal Contamination of Hot Sauce & Chili Powder

Introduction

The consumption of botanical products has increased over the past two decades as consumers trend to what are perceived to be natural and high quality botanical products. The primary regions of spice and tea production around the world have often been cited as having less stringent safety and quality standards in regards to consumer products. Products from these regions have been noted to contain a variety of adulterants and contaminants including wear metals and toxic elements.

Spices and hot sauces were purchased at dollar stores, farmer's markets, chain stores, and online. Products included organic products. Cryogenic grinding and microwave digestion were employed in sample processing. ICP-MS was used to determine the presence and level of heavy metal contamination and adulteration.

Methods & Materials

Samples

The samples ranged in price from \$1 per bottle to more than \$20 per ounce. Some products were designated as 'organic'. In this application note, the focus will be the concentration of chili powder and hot sauce for heavy metal contamination.

- Red Pepper Products (Chili Powder & Hot Sauce):
 - 7 Chili Powders – 1 Organic (\$1-\$8 / 100 g)
 - 6 Hot Sauces – 1 Organic (Free - \$3 / 100 g)

Sample Preparation

Sample Digestion:

- Samples were digested using a CEM Mars 5 Microwave.
 - Microwave conditions:
 - Easy Prep vessels & XP vessels
 - 0.2 g sample
 - 10 mL HNO₃:
 - 1-2 drops HF in samples with high silica content
 - 15 minute ramp to 210 °C
 - 15 minute hold

Materials

- Spex CertiPrep Standards:
 - CLMS-1, CLMS-2, CLMS-3, CLMS-4 (Multi-Element Solution Standards 1-4)
- Reagents:
 - High Purity Nitric Acid
 - High Purity HF

Instrumentation

- Agilent ICP-MS 7700:
 - Meinhard nebulizer
 - Cyclonic spray chamber
- Analysis performed:
 - Normal mode: Air
 - Collision mode: Helium

Results & Discussion

Mixed Chili Powder & Hot Sauces

The red pepper products consisted of blended ‘chili’ powder spices of unknown composition and red pepper hot sauces. The most prevalent heavy metal for the red pepper products was chromium up to 7 µg/g in a dollar store chili powder. Levels of chromium ranged from 3.1 to 7.0 µg/g. Arsenic and cadmium were highest in the same dollar store chili powder which contained the highest chromium levels (1.2 µg/g Cd & 0.4 µg/g As). Lead was also found in this same sample at just less than 1 µg/g. The highest lead content of the mixed chili powders was in the organic chili powder (1.6 µg/g). (Fig. 1).

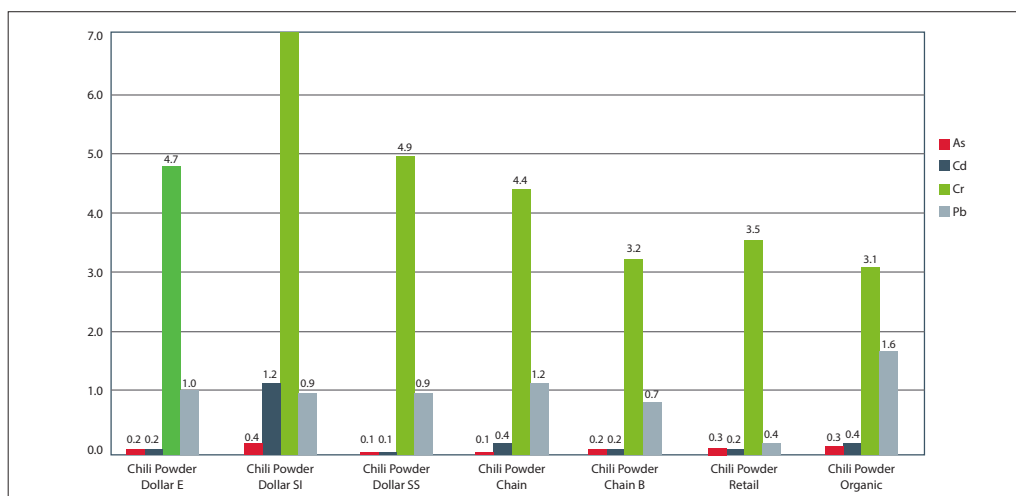


Figure 1. Heavy metals in ‘chili’ powder blends (µg/g).

The highest lead levels, in terms of exposure, were in the commercially prepared red pepper sauces. Some of the sauces were packaged in individual servings of about 10 g per packet. The serving size of two packets or 20 g was used to compare heavy metal concentrations. Two packets of the Chinese fast food hot sauce contained 20.6 µg of lead and 63 µg of chromium which would contribute to almost 30% of an adult’s allowable daily limit for each element. Lead and chromium were consistently found in all the hot sauces tested. Some of the samples also included measurable amounts of arsenic and cadmium. (Fig. 2).

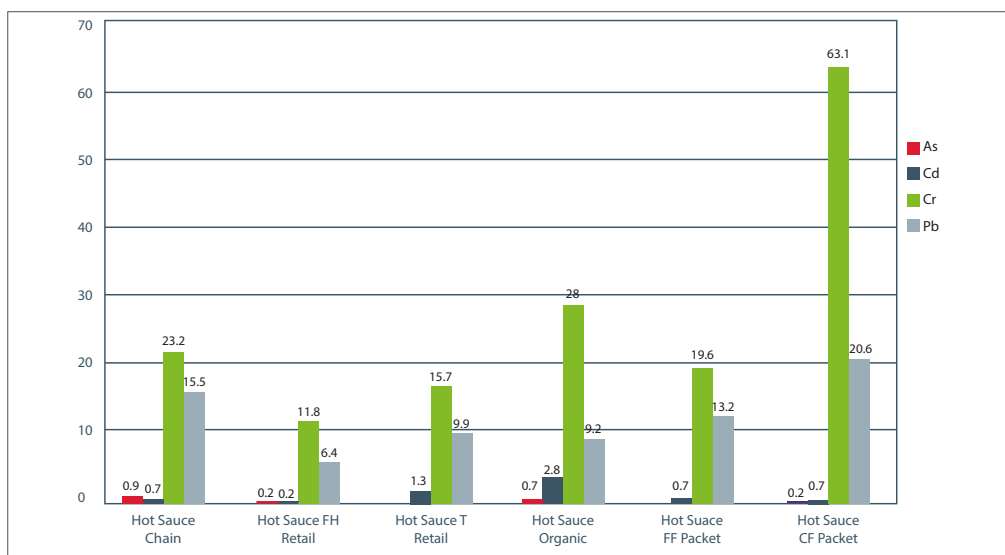


Figure 2. Heavy metal concentrations in hot sauce (µg/20 g serving = 2 fast food packets).

Conclusions

The chili powder and hot sauces we tested all contained some notable amounts of heavy metals. The most prevalent heavy metals found were lead and chromium. The dry spices had the highest concentrations of both lead and chromium but the exposure to these concentrations was minimized by the typical serving of these dry spices. However, the hot sauces, which did have lower overall concentrations of heavy metals, in comparison with the dry spices, had high exposure levels when looked at within the context of serving size. In the case of some of the hot sauce packets, two packets would contain over a quarter of an adult's exposure to chromium and lead for the day.

Red pepper products, when compared to our other study spices, contained some of the highest overall concentrations of heavy metals only exceeded by some cinnamon and turmeric samples for the highest levels of lead. Red pepper and chili powder blend samples did contain the highest amounts of arsenic and cadmium found in all the spices. The only heavy metal not found in significant concentrations in red pepper spices was mercury. (Fig. 3).

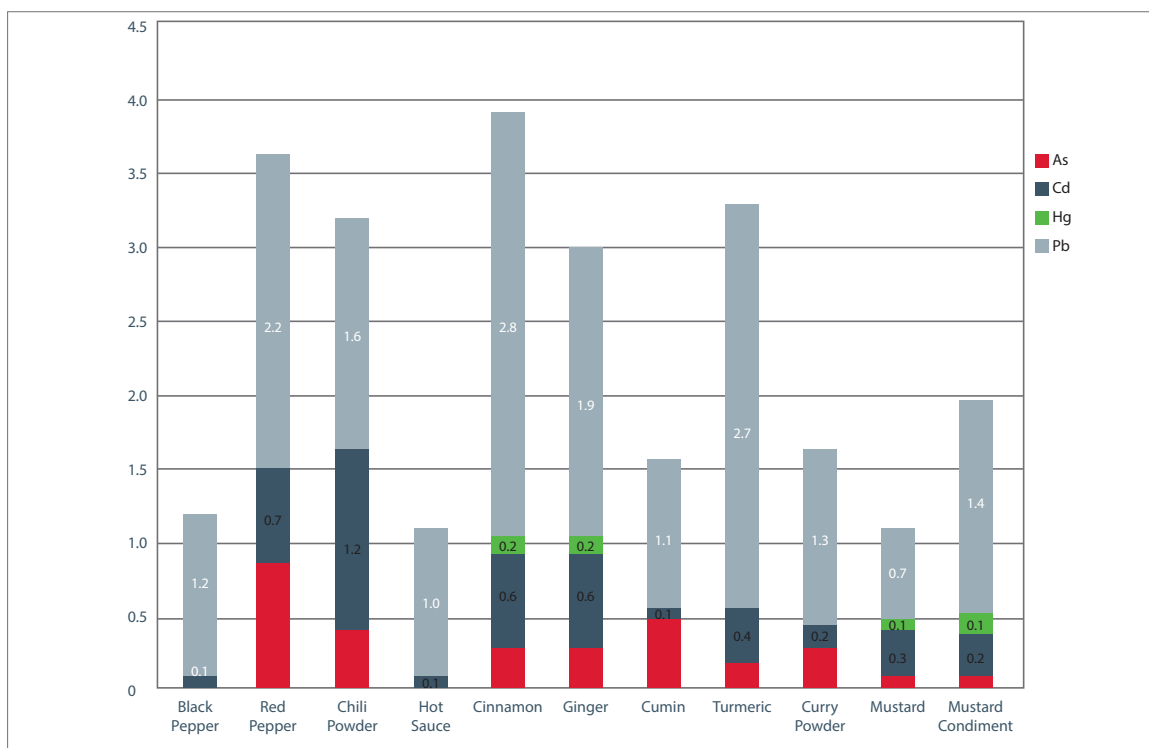


Figure 3. Comparison of overall concentration of heavy metals in spice sample groups (µg/g).