

February 19, 2016

Dear friends and colleagues,

In the past weeks, since news first broke of the “Flint Water Crisis,” our lab has been inundated with calls about how potentially tainted water might affect Flint’s cannabis. There is a great deal of fear and speculation.

The issue of heavy metals in cannabis is complex, with relatively few data available. That said, as a geochemist and metals expert I thought I could offer some much needed insight on how the Flint water crisis could potentially affect that area’s medical cannabis, or rather, on how **unlikely** it is to be a significant problem.

Firstly, there are a couple of key aspects to the water situation itself that make it somewhat unlikely to affect growing cannabis. Most cannabis growers are very aware of their water chemistry and the effects that it has on keeping their plants healthy. It's likely that many Flint growers, like growers everywhere, are using clean sources of water like those treated with reverse osmosis (RO) systems to remove contaminants in order to purify the water.

Even if the water they use is very clean, heavy metals could be introduced from other sources that are completely independent of that, such as trace contaminants in the fertilizers being used by growers. Also, from what I understand the lead contamination in Flint is highly variable by location relating to the extent of corrosion on local pipes, thereby also lowering the risk that any one given grow is experiencing high background lead levels in the water.

There are also some really important things to consider about the biology of cannabis itself when evaluating the possible transfer of heavy metals such as lead into your body by using cannabis that was grown with lead contaminated water.

While I do caution that the data are very, very limited, some of the only available data on the uptake of heavy metals by cannabis plants suggest that these metals only reach high concentrations in the roots of cannabis plants and do not get transferred into the leaves (no data on flowers are available). This is important because different plants have evolved very different tolerances and biochemical means for dealing with heavy metals in soils.

Some plants can't tolerate very much heavy metal in the soil and will suffer adverse health reactions or die if levels are too high. Others can thrive with extremely high amounts and will hyperaccumulate large metal concentrations in tissues even when grown on non-contaminated soils with average to low heavy

metal levels. Cannabis is more in between where it can tolerate relatively large amounts of heavy metals but doesn't seem to hyperaccumulate them.

Also the exclusion of heavy metals from the above ground tissues of cannabis further minimizes the danger posed by smoking flowers when it comes to heavy metals. However, it is also important to note that this study largely focuses on the metal cadmium and does not look at lead at all which is the main contaminant of concern in the Flint crisis.

As an example of what I'm describing above, tobacco plants can actually accumulate relatively high concentrations of cadmium in their leaves even when grown on non-contaminated soils. They can also accumulate elevated levels of lead. Again, this does not seem to be the case for cannabis leaves at least for cadmium.

However the accumulation of heavy metals in cannabis plants is not where the story ends. Intake method can also affect the delivery of these toxic metals to your body. For example, while both lead and cadmium can be elevated in tobacco (relative to something else we consume like food) how much gets into your body while smoking can vary from metal to metal. Some metals will be concentrated in the ash, while others will get into the mainstream and sidestream smoke.

Mainstream smoke also passes through a filter so depending on how that metal occurs in the smoke (as a true gaseous vapor or a particulate) and the efficiency with which that component is filtered. So for example in one review paper I saw from the World Health Organization they claim that while 70% of the cadmium in tobacco passes into the smoke during combustion, only 6% of lead does, so the risk for each metal can be highly variable even if both are present as contaminants.

There are further complications when you consider extractions of cannabis as either smokeable concentrates or into edibles. Extraction of cannabinoids with hydrocarbons as is typically done might actually be a way to clean up contamination from heavy metals in cannabis flowers. This is because the solubility of inorganic heavy metals in organic solvents like butane and ethanol is substantially lower than the solubility of metals in inorganic solvents like nitric and hydrochloric acid. Therefore during extraction, you could leave metals behind in the plant residue as you extract cannabinoids and terpenes into oil. However, there are no data to test this so it is just an idea.

Similarly, when preparing edibles it's unlikely that many metals would end up in the extraction butter/oil. Unless actual plant material is being eaten and exposed to the acidic environment in the digestive system then it is unlikely a lot of metals would be introduced into the body this way.

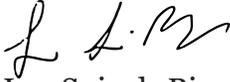
While there a few data and caution should be taken until more studies really answer some of these questions, the data that are currently available suggest that

overall the issue of contaminated water in Flint should have a relatively minimal impact, if any, on the health and safety of medical cannabis users in the area.

It's important to consider all of the available data and facts when evaluating a complex scenario like this and to not let irrational fears drive the decision-making.

As always, I am available to answer any further questions.

Best,

A handwritten signature in black ink, appearing to read 'L. Spivak-Birndorf', written in a cursive style.

Lev Spivak-Birndorf, PhD