Buyer beware: Some water-filter pitchers much better at toxin removal

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Blue-green algal blooms like the one pictured here (Lake Erie, 2009) produce toxic microcystins that threaten human health. Credit: NOAA - NASA, Public Domain

Water pitchers designed to rid water of harmful contaminants are not created equal, new research has found.

Scientists from The Ohio State University compared three popular pitcher brands' ability to clear dangerous microcystins from tap water. They found that while one did an excellent job, other pitchers allowed the toxins—which appear during harmful algal blooms (HABs) - to escape the filter and drop into the drinking water.

The purifier that filtered water fastest, and which was made entirely of coconut-based activated carbon, removed 50 percent or less of the microcystins from the water. But the purifier that filtered water slowest—and which was made from a blend of active carbon—rendered the microcystins undetectable in drinking water. The study appears in the journal *Water Science Technology: Water Supply*.

"Because drinking-water treatment plants also use activated carbon, I figured that these home filters might also remove some microcystins, but I wasn't expecting results this good and such big differences among the pitchers," said Justin Chaffin, the study's lead author and a senior researcher and research coordinator at Ohio State's Stone Laboratory. Stone Lab is located on Lake Erie and serves as a hub for researchers throughout the Midwest working on issues facing the Great Lakes.

Toxin-producing harmful algal blooms (HABs) have become a global threat to drinking water. Microcystins are among the most common toxins that arise from these cyanobacterial blooms, posing a significant risk to animal and human health. Adverse reactions to the toxins can range from a mild skin rash to serious illness or death as a result of damage to the liver or kidneys.

In Ohio, microcystins in Toledo's water supply left more than 400,000 residents without tap water for several days in 2014.

"Since then, many residents drink bottled water and others rely on these filtration pitchers as backup, in case the water treatment plants miss a return of the microcystins," Chaffin said. No such threats to the water have been detected since the 2014 incident, he said.

"At public events, residents kept asking me 'Does my water pitcher remove microcystins?' and my answer was always, 'I don't know,'" Chaffin said.

So he designed a study to answer the question.

The researchers do not name the brands in the study, but they are commonly found in retail outlets and ranged in price from about $15 to about $50, Chaffin said. Interested consumers can compare the study findings to the features of an individual pitcher to inform their purchasing decisions, he suggested.

"In general, the cheaper the pitcher, the worse job it did filtering out the toxins," Chaffin said.

Chaffin and his collaborators used contaminated Lake Erie water, which they diluted to various concentrations of microcystins, and then ran through three common pitchers designed to purify water. Consistently, slow filtration and a combination of different types of activated carbon proved most helpful.

The idea behind the pitchers is that the activated carbon in the filter "grabs" bad things from the tap water as they bind to the carbon molecules.

When water with a microcystin concentration of 3.3 micrograms per liter was run through the three filters, its concentration dipped in all cases, but was only undetectable in one pitcher—the slowest-filtering model. The researchers chose that concentration to mimic the concentration reported during the 2014 do-not-drink advisory in Toledo.

"Contact time really seems to matter. If you run the water through really fast, the microcystins and other organic molecules don't have time to bind to the carbon molecule and stick to the filter," Chaffin said.

Contact time varied from a little more than two minutes per liter (for the worst-performing pitcher) to more than six minutes per liter (for the best). The middle-of-the-road pitcher filtered water at a rate of almost four minutes per liter.

The two most-effective pitchers had filters made of a blend of activated carbon sources. The least-effective pitcher's filter was made entirely of coconut-based active carbon.

The research team also tested whether the microcystins stayed put on expired filters by running ultra-clean deionized water through the purifier.

"We didn't find the microcystins in that filtered water at all, so there's a pretty good chance that what's being removed is stuck to the filter for good," Chaffin said.

That said, he suggested that these purifying pitchers be viewed as a safety net for those who are worried about microcystins going undetected at the drinking-water treatment plants—not in cases where there's been a warning and people have been told to stick to bottled water.

"But when there isn't a warning, these filters are much cheaper and better for the environment in the long run than bottled water. You aren't creating mountains of empty bottles," Chaffin said.

Provided by The Ohio State University