

TOLEDO WATER DANGER UNCLEAR

SAFETY: Algal contaminants have varying toxicities

A N ACADEMIC LAB on Aug. 7 released test results of water from Lake Erie that paint a more complicated, and possibly less toxic, picture of the potential health hazards from the presence of algal toxins in the tap water of Toledo, Ohio. Residents were ordered not to drink from their taps for several days.

On Aug. 1, the Collins Park Water Treatment Plant, which treats Toledo's Lake Erie-based water supply, found elevated levels of microcystins, a class of more than 90 related compounds that are produced by blue-green algae, or cyanobacteria, and which are highly toxic to the livers of humans and other animals.

The situation prompted the Ohio Environmental Protection Agency to order the temporary tap water ban, which was lifted on Aug. 4.

But the true danger posed by the microcystin contamination remained unclear because scientists didn't know exactly which microcystins were present, says Gregory L. Boyer, acting director of the Great Lakes Research Consortium. He notes that algae found in Lake Erie produce different microcystins with varying toxicities.

Without knowing which microcystins were involved, overall levels detected in Toledo tap water "say nothing about toxicity in humans," Boyer points out.

But now Boyer's lab—which is independent of government labs—reports that samples taken on Aug. 4 of Lake Erie's contaminated water contained 60–80% microcystin-LR, 10–25% microcystin-RR, and 5–15% microcystin-YR.

Microcystin-LR is considered to be the most toxic, microcystin-RR is half as toxic as the LR variant, and microcystin-YR is somewhere in between the two.

The World Health Organization's recommended safe limit of microcystin in water of 1.045 µg per liter is based on the toxicity of microcystin-LR. The new results suggest that the actual toxicity to people in Toledo may have been overestimated.

On Aug. 1, prompted by the presence of a bloom of blue-green algae, the Toledo water facility performed tests that showed elevated microcystin levels.

Continued daily testing showed levels that exceeded WHO's recommendations, reaching 2.5 µg/L, according to a statement from the Toledo-Lucas County Health Department. But by Aug. 4, they were below 1.0 µg/L.

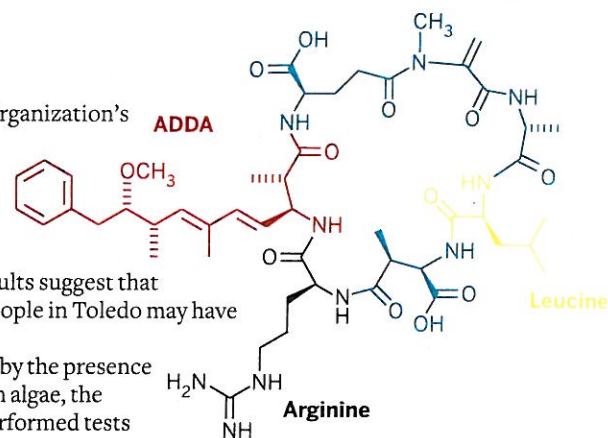
The tests use enzyme-linked immunosorbent assays and are not able to differentiate among microcystin variants. Instead, they report the presence of ADDA, an unusual amino acid present in all microcystins.

Other testing techniques, such as reversed-phase HPLC or Raman spectroscopy can separate different microcystins, but they are time and labor intensive. Boyer's lab relied on an LC/MS screening method.

Microcystins are difficult to remove from water. They are cyclic peptides, which are stable even at high temperatures. Microcystins are even impervious to enzymatic degradation, Boyer says, because they contain unusual linkages that normal enzymes don't recognize.

The recent contamination was mitigated by a number of factors, says Ohio EPA spokeswoman Heidi Griesmer. Weather conditions helped dilute the toxins, and the treatment facility added extra powdered activated carbon, alum, and chlorine to the water supply, she says.

The carbon powder readily adsorbs microcystins; alum causes any remaining algae to clump together and settle out of the water; and chlorine, along with sunlight, can oxidize an unsaturated double bond in ADDA, leading to chemical breakdown of the toxins.—ELIZABETH WILSON



Microcystin-LR is the most common and most toxic of the microcystins. The two-letter nomenclature refers to the two amino acids, leucine and arginine, that distinguish it from other members of the class.

OPEN ACCESS White House rules for federally funded research go into effect at DOE

The Department of Energy's Office of Science announced on Aug. 4 how it will provide free public access to the results of DOE-funded research within 12 months of its publication.

The Public Access Gateway for Energy & Science (www.osti.gov/pages) will provide links to published articles or journal-accepted, peer-reviewed manuscripts. The DOE website is the first agency response to a 2013 White House memo requiring all federal agencies funding more than \$100 million of research

per year to make the results of that work freely available.

John C. Vaughn, executive vice president of the Association of American Universities, says DOE is allowing papers to stay behind a paywall for 12 months, which is a shorter period than many publishers had wanted, before they are made freely available to the public. He expects other federal agencies to strike similar middle ground.

DOE is working with a consortium of more than 100 publishers that operates

CHORUS (Clearinghouse for the Open Research of the U.S.), which helps link articles on publishers' websites to open access databases.

Public access to articles on a publisher's website ensures that readers are looking at the most up-to-date presentation that would reflect any corrections or retractions, says Susan King, chair of the consortium. King is senior vice president of the Journals Publishing Group at the American Chemical Society, which publishes C&EN.—ANDREA WIDENER