United States Environmental Protection Agency

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2015 Drinking Water Health Advisories for Two Cyanobacterial Toxins

Summary

EPA has issued 10-Day Drinking Water Health Advisories (HAs) for the cyanobacterial toxins microcystins and cylindrospermopsin.

EPA recommends HA levels at or below 0.3 micrograms per liter for microcystins and 0.7 micrograms per liter for cylindrospermopsin in drinking water for children pre-school age and younger (less than six years old). For school-age children through adults, the recommended HA levels for drinking water are at or below 1.6 micrograms per liter for microcystins and 3.0 micrograms per liter for cylindrospermopsin. Young children are more susceptible than older children and adults as they consume more water relative to their body weight.

HAs are non-regulatory values that serve as informal technical guidance to assist federal, state and local officials, and managers of public or community water systems to protect public health from contaminants. EPA has also published health effects support documents for the cyanobacterial toxins microcystins and cylindrospermopsin. These documents contain the health effects basis for the development of HAs for the protection of human health. In addition, EPA has published a health effects support document for anatoxin-a but concluded that there was not adequate information to support a health advisory for this toxin.

Background

What are cyanobacterial toxins?

Cyanobacteria, common to freshwater and marine ecosystems, can under certain conditions (high nutrient concentrations and high light intensity) form scums or "blooms" at the surface of a water body. These blooms can produce toxic compounds (cyanobacterial toxins or "cyanotoxins") that are harmful to the environment, animals and human health. Winds and water currents can transport cyanobacterial blooms within proximity to drinking water intakes at treatment plants that, if not removed during treatment, can cause odor, taste and color problems in treated drinking water and can be harmful to human health.

What is a health advisory?

The Safe Drinking Water Act provides the authority for EPA to publish health advisories for contaminants not subject to any national primary drinking water regulation. Health advisories describe non-regulatory concentrations of drinking water contaminants at or below which adverse health effects are not anticipated to occur over specific exposure durations (e.g., one-day, 10-days, several years, and a lifetime). They serve as informal technical guidance to assist federal, state and local officials, and managers of public or community water systems by providing information on the health effects of and methods to sample and treat cyanobacterial toxins in drinking water. HAs are not legally enforceable federal standards and are subject to change as new information becomes available.

Why has EPA taken this action?

There are no U.S. federal guidelines, water quality criteria, standards or regulations for cyanobacteria or cyanotoxins in drinking water under the Safe Drinking Water Act or in surface waters under the Clean Water Act. However, EPA has listed cyanotoxins including microcystin-LR, cylindrospermopsin, and anatoxin–a on the previous and current Contaminant Candidate Lists (CCL), which identify contaminants that may need regulation under the Safe Drinking Water Act.

EPA found there are adequate health effects data to develop HAs for microcystins and cylindrospermopsin, but found the data inadequate to develop an HA for the cyanobacterial toxin anatoxin-a.

How Can I Be Exposed to Cyanobacterial Toxins?

For the cyanotoxin HAs, drinking water is the primary source of exposure. Exposure may also occur by ingestion of toxin contaminated food, including consumption of fish; by inhalation and dermal contact during bathing or showering; and during recreational activities. Effects due to these other routes of exposure cannot be quantified at this time, however, they are assumed to be less than from drinking water ingestion.

What information was used to develop the health advisories for cyanobacterial toxins?

EPA worked with Health Canada and conducted a comprehensive search of the literature from January 2013 to May 2014. The HA includes information on occurrence; environmental fate; mechanisms of toxicity; acute, short term, subchronic and chronic toxicity and cancer in humans and animals; toxicokinetics; health effects and exposure. The HA also includes information on methods for analysis and treatment techniques for removal in drinking water treatment plants.

Health Effects Information

Effects including gastroenteritis, and liver and kidney damage have been reported in humans following short-term exposure to cyanotoxins in drinking water. Recreational exposure to cyanobacterial blooms has been reported to lead to allergic reactions, including hay fever-like symptoms; skin rashes; and gastrointestinal distress. Animal studies have shown that long-term adverse effects from cyanotoxins include liver and kidney damage. However, more research is needed to quantify these effects.

Critical Studies Used

The critical study supporting the microcystins 10-day HA was conducted by Heinze (1999). This study is a 28-day study in rats, whose drinking water contained microcystin-LR. Effects observed included changes in liver weight, liver serum enzymes, and lesions in the liver. The lowest observed adverse effect level (LOAEL) based on these effects was 50 micrograms per kilogram per day, a no observed adverse effect level (NOAEL) was not identified. This dose was selected as the basis for deriving a reference dose (RfD) for microcystins. A total uncertainty factor of 1000 (10 to account for differences between humans and animals, 10 to account for variability in humans, 3 for extrapolation from a LOAEL, and 3 to address database deficiencies) was applied to determine the RfD for microcystins. These values were used along with body weight and drinking water intake for infants and adults to derive the 10-Day HA values. The 10-day HA of 0.3 µg/L is considered protective of non-carcinogenic adverse health effects for bottle-fed infants and young children of pre-school age over a ten-day exposure to microcystins in drinking water. The 10-day HA of 1.6 µg/L is considered protective of non-carcinogenic adverse health effects for children of school age through adults over a 10-day exposure to microcystins in drinking water.

The critical study supporting the cylindrospermopsin 10-day advisory was conducted by Humpage and Falconer (2002, 2003). This study is an 11-week study with cylindrospermopsin administered to male mice by gavage. Effects observed included increases in kidney weight. The NOAEL from this study was 30 micrograms per kilogram per day and the LOAEL based on kidney weight changes was 60 micrograms per kilogram per day. The NOAEL of 30 micrograms per kilogram per day was selected as the basis for the RfD. A total uncertainty factor of 300 (10 to account for differences between humans and animals, 10 to account for variability in humans, and 3 to address database deficiencies) was applied to determine the RfD for cylindrospermopsin. These values were used along with body weight and drinking water intake for infants and adults to derive the 10-Day HA values. The 10-day HA of 0.7 µg/L is considered protective of non-carcinogenic adverse health effects for bottle-fed infants and young children of pre-school age over a 10-day exposure to cylindrospermopsin in drinking water. The 10-day HA of 3 µg/L is considered protective of non-carcinogenic adverse health effects for children of

school age through adults over a 10-day exposure to cylindrospermopsin in drinking water.

As the science on the health impacts of algal toxins continues to improve, EPA will track developments and update recommendations as appropriate.

Additional EPA support document to assist states and utilities in managing cyanobacterial toxins

EPA has also published a cyanotoxin management document as a companion to the HAs. The document is designed to provide information and a framework that Public Water Systems and others can consider to inform their decisions on managing the risks from cyanotoxins to drinking water. It includes a potential stepwise approach these systems could use to inform their decisions on whether and how to monitor and treat water, and communicate with stakeholders.

Where can I find more information?

To learn more about the HAs for microcystins and cylindrospermopsin and to view the health effects support documents for these and anatoxin-a in drinking water, visit EPA's Health Advisory webpage: http://water.epa.gov/drink/standards/hascience.cfm. To learn about additional strategies Public Water Systems and others could consider in managing cyanotoxins, visit EPA's CyanoHABs website: http://www2.epa.gov/nutrient-policy-data/guidelines-and-recommendations

References

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