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Algal Toxins in Drinking Water: EPA Health Advisories

On June 17, 2015, the Environmental Protection Agency (EPA) issued drinking water health advisories for two algal toxins to help water providers address threats to drinking water supplies from harmful algal blooms (HABs).

Blue-green algae (cyanobacteria) occur naturally in marine and fresh water and can produce numerous potent algal toxins (cyanotoxins). Exposure to cyanotoxins can cause a range of adverse health effects, from rashes to severe illness and, rarely, death. A confluence of conditions—including warm water temperatures, excess nutrients (mainly nitrogen and phosphorus) and strong sunlight—can trigger explosive growth of cyanobacteria, creating harmful algal blooms. These HABs can contaminate drinking water supplied from surface water or groundwater directly influenced by surface water. Further, HABs appear to be increasing. EPA's 2009 National Lakes Assessment found microcystins, one of the more common and potentially harmful cyanotoxins, to be present in one-third of lakes surveyed nationwide.

In August 2014, microcystins produced by a bloom in Lake Erie contaminated a water system serving Toledo, Ohio, and surrounding areas for several days. No federal drinking water standards were available for managing this or other cyanotoxins, nor were rapid and sufficiently specific analytical methods available to meet the needs of water providers faced with quickly identifying, measuring, and removing the toxins to ensure the safety of water supplies. As a trigger for taking action, water managers used the state guideline of 1 microgram per liter (µg/L) for microcystin-LR (one of the more common and harmful variants of microcystin). The immediate problem was resolved; however, this and other incidents added urgency to EPA's efforts to assess cyanotoxin risks to public water supplies.

EPA has been conducting research on several common cyanotoxins—microcystins, cylindrospermopsin, and anatoxin-a—and evaluating them for possible regulation under the Safe Drinking Water Act (SDWA). The agency has also worked to validate analytical methods to enable the measurement of these cyanotoxins in water at lower concentrations and with greater accuracy and precision. However, technical challenges and information gaps on the toxins' health effects and occurrence have thus far prevented EPA from determining whether the cyanotoxins meet the criteria for regulation under the SDWA.

In light of the impacts of the Lake Erie HAB and the increasing frequency of HABs nationwide, EPA set a goal to issue health advisories for the three types of cyanotoxins ahead of the 2015 summertime algal bloom season.

Drinking Water Health Advisories

The SDWA authorizes EPA to issue health advisories for contaminants that are not regulated under the act (42 U.S.C. §300g-1(b)(1)(F)). Health advisories include non-enforceable guideline values for contaminants in drinking water (based on non-cancer health effects) and often include values for different exposure durations: one day, 10 days, several years, and lifetime. Advisories also provide technical guidance on identifying, measuring, and treating contaminants in drinking water.

On June 17, 2015, EPA issued several resource documents related to HABs, including drinking water health advisories for microcystins and cylindrospermopsin (80 *Federal Register* 34637). Because of insufficient health effects data, EPA was unable to issue an advisory for anatoxin-a.

The advisories include levels for the cyanotoxins in drinking water at or below which adverse health effects are not expected to occur based on short-term (10-day) exposures (**Table 1**). They also include information on analytical methods that water providers can use to test for the presence and concentrations of the toxins and treatment techniques to remove them from drinking water.

EPA also issued *Recommendations for Public Water Systems to Manage Cyanotoxins in Drinking Water*, a technical document to help water providers develop cyanotoxin management strategies (e.g., determining when and how to monitor and treat water and when and how to notify the public and officials at different toxin levels).

Table 1. Cyanotoxin Health Advisory Levels
10-day exposures, micrograms per liter (µg/L)

	Microcystins	Cylindrospermopsin
Children less than 6 years old	0.3	0.7
Ages 6 and older	1.6	3.0

Source: EPA, 2015 Drinking Water Health Advisories for Two Cyanobacterial Toxins, Fact Sheet, http://water.epa.gov/drink/standards/hascience.cfm#micro.
Notes: EPA recommends utilities issue "do not drink, do not boil" notices when toxins exceed values for ages 6 and older. Targeted notification for sensitive groups is suggested when toxin levels exceed the lower value but not the higher value. EPA worked with Health Canada to develop health advisories. The World Health Organization (WHO) issued a provisional drinking water guideline for microcystin-LR of 1 µg/L in 1998. Ohio and Oregon use this same guideline level. Minnesota set a guidance level of 0.04 µg/L. Seventeen countries have adopted microcystin-LR guidelines ranging from 1.0 µg/L to 1.5 µg/L.

While broadly supporting EPA efforts, the American Water Works Association has noted technical, policy, and cost issues with the recommendations document and has asked

EPA to classify the document as "economically significant" and to reissue it after allowing public review and comment. One issue concerns the feasibility of using two advisory levels for each toxin, each with different risk management recommendations. Another of the issues concerns the effectiveness of certain recommended testing methods (http://www.awwa.org/legislation-regulation.aspx).

Federal Drinking Water Standards

The SDWA authorizes EPA to regulate and set enforceable standards for drinking water contaminants and lays out a process for doing so. First, EPA is required to regularly prepare contaminant candidate lists (CCLs) that identify contaminants that may require regulation. In 1998, EPA included cyanobacteria and their toxins as candidates for regulation on the first list (CCL 1). EPA's 2009 list (CCL 3) and draft CCL 4 include the cyanotoxins microcystin-LR, anatoxin-a, and cylindrospermopsin.

EPA then must make regulatory determinations for at least five listed contaminants every five years. To make a determination to regulate, the Administrator must find that (1) the contaminant may have adverse health effects, (2) it occurs (or is likely to occur) in public water supplies at levels and frequencies of concern, and (3) its regulation presents a meaningful opportunity to reduce health risks.

EPA reports that current scientific understanding of the risk of exposures to low levels of cyanotoxins is too uncertain to support setting standards. Further, information on the frequency and levels of occurrence of the cyanotoxins in public water supplies is limited. To gather occurrence data, the SDWA directs EPA to administer a monitoring program for unregulated contaminants. EPA plans to issue its fourth Unregulated Contaminant Monitoring Rule (UCMR 4) in 2017 to require public water systems to monitor for 30 unregulated contaminants for the period 2017-2021. The UMCR 4 is expected to include the three cyanotoxins.

The complexity of cyanobacteria and their toxins impedes regulatory control. EPA reports that a single cyanobacteria species can produce multiple toxins or no toxins, while different species can produce the same toxins. Further, a single toxin can have numerous "sub-species." (Researchers have identified more than 80 variants of microcystins.) Cyanotoxins can occur outside or inside cells; in the latter case, if the cell walls break, more toxins are released. This complexity also poses testing and treatment challenges. Although effective treatment options are available, water providers must be able to identify toxins accurately to select appropriate treatment method(s), because the wrong treatment can cause some bacteria to release more toxins.

Congressional Actions

The 114th Congress has acted to address cyanotoxins in drinking water. H.R. 212 and S. 460 (the Drinking Water Protection Act) were introduced to require EPA to submit to Congress a detailed plan to assess and manage risks of algal toxins in public water supplies. In February 2015, the Environment and the Economy Subcommittee of the House Energy and Commerce Committee held a hearing on microcystins in drinking water; the full committee reported H.R. 212, amended, and the House passed H.R. 212. The Senate passed H.R. 212 on August 5, 2015, without amendment, and the President signed the bill into law on August 7 (P.L. 114-45). The law requires EPA to include in the strategic plan steps and schedules for EPA to assess health risks of algal toxins in drinking water, publish a list of toxins likely to pose risks and summarize their health effects, determine whether to issue health advisories, publish guidance on feasible methods to identify and measure the algal toxins in water, recommend feasible treatment methods, etc. Further, P.L. 114-45 requires the Government Accountability Office to report on federal HAB-related expenditures for FY2010 through FY2014.

Related bills, the Safe and Secure Drinking Water Act of 2015 (H.R. 243 and S. 462), were introduced to direct EPA to publish a microcystins health advisory within 90 days of enactment. These bills would also require EPA to report annually to Congress—until EPA made a regulatory determination for microcystins—on the status of the determination and efforts promote testing and treatment.

HABs Prevention

Water providers and others have urged actions to reduce the formation of HABs so that communities are not faced with the resulting health risks and costs. Beyond drinking water impacts, HABs can harm pets, wildlife, and livestock; contaminate fish; halt recreational activities; and cause other economic losses. Nutrients play a key role in the development of HABs, and major nutrient sources include agricultural runoff, discharges from sewage treatment plants, and storm-water runoff from lawns and streets. Reducing nutrient loading of waterways would help reduce HABs. Strategies include changing fertilizer and manure management practices, increasing sewage treatment to remove phosphorus, controlling storm-water runoff, and setting limits on point-source discharges to surface waters.

Among other federal actions, the U.S. Department of Agriculture has targeted funds for conservation activities to improve conditions in Lake Erie. (See CRS Report R43919, *Nutrients in Agricultural Production: A Water Quality Overview*.) Funding has also been provided through the Great Lakes Restoration Initiative. Similarly, Clean Water Act (CWA), Section 319, authorizes EPA to provide state grants to help address nonpoint pollution sources (e.g., runoff from farmland and streets). Further, under CWA Section 304, EPA is developing water quality criteria for these toxins for recreational waters. States could use the criteria to develop water quality standards and set discharge limits in permits for pollutants that contribute to HABs.

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