# Researchers reveal key to how bacteria clear mercury pollution

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Mercury pollution is a persistent problem in the environment. Human activity has lead to increasingly large accumulations of the toxic chemical, especially in waterways, where fish and shellfish tend to act as sponges for the heavy metal.

It's that persistent and toxic nature that has flummoxed scientists for years in the quest to find ways to mitigate the dangers posed by the buildup of mercury in its most toxic form, methylmercury.

A new discovery by scientists at the University of Tennessee, Knoxville, and Oak Ridge National Laboratory, however, has shed new light on one of nature's best mercury fighters: bacteria.

"Mercury pollution is a significant environmental problem," said Jeremy Smith, a UT-ORNL Governor's Chair and lead author of the new study. "That's especially true for organisms at or near the top of the food chain, such as fish, shellfish, and ultimately, humans. But some bacteria seem to know how to break down the worst forms of it. Understanding how they do this is valuable information."

Scientists have known that a specific enzyme, known as MerB, gives the bacteria the ability to convert methylmercury into a less-toxic form of mercury that poses substantially less environmental risk, a trait that lets them survive in mercury-rich environments. Finding out how this enzyme works potentially may be a viable way to combat methylmercury.

The UT Knoxville and ORNL researchers, working with colleagues from the University of Georgia and University of California, San Francisco, were able to determine the mechanism -- at the most detailed level -- of how the MerB enzyme breaks apart the dangerous methylmercury molecule.

The scientists used high-performance computers to determine how the three-dimensional structure of the enzyme uses a sort of one-two-three punch to break apart a key link in the methylmercury, between mercury and carbon atoms. Once that bond is broken, the resulting substance is on the way to becoming substantially less harmful to the environment.

Knowing the exact layout of atoms within both the methylmercury and the MerB enzyme, the researchers found out how the enzyme creates an electric field that shifts around electrons in the methylmercury, priming the toxin for deconstruction. The research is a feat that would have been impossible only a year ago. By using increasingly powerful tools, scientists are able to see much more clearly how the "puzzle pieces" of chemical reactions interact.

The next challenge researchers face will be to find a way to take this new understanding of how methylmercury can be broken down and apply it in an ecosystem at large. At least in concept, using these types of bacteria or hijacking the chemical principles they use may provide a way to combat the buildup of methylmercury.

"There's definitely more work to be done in finding ways to build on what we've learned," said Jerry Parks, an ORNL staff scientist and co-author of the study. "But, we're optimistic that these findings can lead to a productive way to address mercury in the environment."

More information: The study, titled "Mechanism of Hg-C protonolysis in the organomercurial lyase MerB" was published online in the most

recent *Journal of the American Chemical Society*. An abstract can be viewed online at pubs.acs.org/doi/full/10.1021/ja9016123

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