

Toxins from algal blooms may cause Alzheimer's-like brain changes

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Taken in October 2011, the worst algae bloom that Lake Erie has experienced in decades. Credit: NASA Earth Observatory

A group of villagers on the Pacific island of Guam has offered some key insight into the role that an environmental toxin may play in brain changes that are a hallmark of Alzheimer's disease. And scientists studying that neurotoxin appear to have found a possible antidote.

In some Chamorro residents in Guam, Army physicians in the 1950s identified a paralytic disease that had similarities to Parkinson's disease, amyotrophic lateral sclerosis (ALS, better known as Lou Gehrig's disease) and dementia. Scientists later observed that upon the death of those affected by Guamanian amyotrophic lateral sclerosis-parkinsonism-dementia complex, their brains were found to be riddled with the same kinds of amyloid protein clumps and tangles of neural fibers that are routinely seen in the brains of those with Alzheimer's disease.

In hunting for the cause of the Guamanian affliction, scientists' suspicions have fallen on an environmental toxin—the amino acid beta-N-methylamino-L-alanine (or L-BMAA). Produced by a wide range of cyanobacteria, L-BMAA is plentiful in algal blooms and can be found in some sea creatures—sharks, bottom-dwelling fish and shellfish—who ingest such algae. It has been implicated in the elevated rates of ALS among soldiers in the 1991 Persian Gulf War, who may have inhaled high concentrations of L-BMAA in desert dust.

Among the Chamorro who were studied, L-BMAA had made its way in high doses into their diets, largely in the tissue of flying foxes. It could take years of eating tainted meat or flour before a villager might develop the disabling disease. But even when outsiders came to Guam and ate what locals ate, they were likely to become ill—which suggested an environmental toxin might be to blame.

With those clues in hand, scientists from the Institute for EthnoMedicine in Jackson Hole, Wyo., decided to test the effects of ingested L-BMAA in vervets, a monkey native to Africa. Over 140 days, they fed one group

of vervets fruit laced with L-BMAA-in a dose that would approximate a lifetime dose of L-BMAA for a Chamorro villager. Another group got a dose one-tenth as high, and a third group got the high dose of L-BMAA and an equal dose of an amino acid supplement called L-serine. A fourth group got fruit with a neutral placebo added.

After the 140 days, tangles and amyloid deposits were found in the brain tissues of all of the vervets who consumed L-BMAA. But the vervets that got the L-serine with the L-BMAA fared far better: They had neurofibrillary tangles that were significantly less dense than those seen in monkeys that got L-BMAA alone.

The new report appeared Tuesday in the British journal *Proceedings of the Royal Society B: Biological Sciences*.

The human body synthesizes L-serine-an amino acid that is key to muscle growth, a healthy immune system and the metabolism of fats, fatty acids and cell membranes. In collaboration with the Institute for EthnoMedicine, Phoenix Neurological Associates is currently conducting a preliminary clinical trial of L-serine supplementation in people diagnosed with ALS. That trial is expected to produce results by the end of this year.

Deborah Mash, director of the University of Miami Brain Endowment Bank and coauthor of the study, said its findings offer strong evidence that L-BMAA causes neurodegenerative disease-a link long suspected but still a surmise.

"The tangles and amyloid deposits produced were nearly identical to those found in the brain tissue of the Pacific Islanders who died from the Alzheimer's-like disease," she said.

The findings also offer tantalizing evidence that a readily available

dietary supplement might help counter the neurodegenerative effects of some environmental toxins, and may help patients with diseases such as Parkinson's, ALS or Alzheimer's.

Ethnobotanist Paul Alan Cox, one of the study's authors, said that "much more research is needed" on the safety and effectiveness of L-serine before it would be wise for humans to begin using the supplement to ward off disease. But he said vervets, who quickly developed the [brain changes](#) seen in Alzheimer's disease, "may prove useful in evaluating other potential new Alzheimer's drugs."

The Institute for EthnoMedicine is a nonprofit research organization dedicated to discovering new cures for neurodegenerative diseases from studies of indigenous peoples. It's established a consortium of 50 scientists operating at 28 institutions in 10 countries.

More information: Dietary exposure to the environmental toxin BMAA triggers neurofibrillary tangles and amyloid deposits in the brain, *Proceedings of the Royal Society B: Biological Sciences*, [rspb.royalsocietypublishing.org/doi/10.1098/rspb.2015.2397](https://rsb.royalsocietypublishing.org/doi/10.1098/rspb.2015.2397)

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