Brain toxin found in algae in water

Possible link to Alzheimer's, other ills studied

By SUSANNE QUICK and JOHN FAUBER
squick@journalsentinel.com

Posted: April 4, 2005

An environmental toxin linked to common neurodegenerative diseases such as Alzheimer's, Parkinson's disease and amyotrophic lateral sclerosis has been found in blue-green algae-contaminated water throughout North America and the world.

 The international team of researchers that reported the finding this week suggested that public health officials now should consider monitoring for the neurotoxin in waters that have blue-green algae "blooms," including water from the Great Lakes and smaller inland waters. The neurotoxin is called B-N-methylamino-L-alanine, or BMAA.

"We don't want to be alarmist. This is very preliminary research," said Paul Allen Cox, lead researcher on the paper and director of the National Tropical Botanical Garden, a research institute in Hawaii.

"But gosh, if there is a neurotoxin out there" it might be prudent to check it out, he said.

The research appears in this week's issue of the Proceedings of the National Academy of Sciences.

Other researchers agree that the work is interesting and warrants further investigation. But they, too, caution it is only suggestive, and no link between blue-green algae and common neurodegenerative diseases has yet been established.

"This is certainly very interesting science, and we're keeping an eye on it. However, its relevance to Alzheimer's disease has yet to be proven," said William Thies, vice president for medical and scientific affairs at the Alzheimer's Association.

The story of Cox and his team's work begins in the early 1900s, when researchers noticed that a large number of Chamorro people - an indigenous population living in Guam - were dying of an unusual, paralytic disease that resembled ALS but had Alzheimer's and Parkinson's disease-like symptoms, too.

Investigators pointed to a tree called the cycad. Its seeds, which the Chamorro used for flour, showed trace levels of BMAA. A strain of cyanobacteria - or blue-green algae - grows inside cycad roots, where it produces BMAA. From there, it is transported throughout the plant, including to the seeds.

But in the 1990s, the theory was discounted. Research showed that while BMAA can cause neurodegeneration in monkeys, in order to get toxic effects from cycad flour, a person would have to eat a

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heck of a lot of it, Cox said.

Intrigued, Cox, an ethnobotanist, set out to find out what was killing these people. He took an expedition to Guam that was partly funded by Verne and Marion Read, two Milwaukee-based philanthropists.

Cox knew the Chamorro were eating fruit-eating bats that foraged on cycad trees. Maybe there was a "DDT effect" going on there, he thought: bio-magnification of a toxin through the food chain.

He examined bat tissue and discovered a 10,000-fold increase in BMAA concentration from seed to bat. This suggested to him that the Chamorro were unwittingly ingesting high levels of the neurotoxin.

He then decided to look at brain tissue from Chamorros who had died of the neurodegenerative disease. To control for possible baseline levels of the molecule, he examined 15 Canadian brains, too.

What he discovered was shocking: While most of the Canadian brains showed no sign of the toxin, two had BMAA molecules.

"Where did they get this molecule?" he asked.

What's more, he said, the two BMAA-positive Canadians had died of Alzheimer's disease - the only two in the sample.

Further investigation revealed similar results: BMAA was discovered in brain tissue from eight Canadian Alzheimer's patients, but not in 14 others who had died from causes other than neurodegeneration. Where were these people coming into contact with BMAA, Cox wondered. And could other strains of cyanobacteria carry this neurotoxin?

To find out, he contacted blue-green algae experts around the globe and asked them to send samples. They complied, and he received samples from rivers, lakes and oceans. Of the 30 samples shipped to him, 29 tested positive for BMAA.

"Holy cow! What's going on?" he wondered. The neurotoxin appeared to be everywhere he looked.

Wayne Carmichael, professor of aquatic ecology and toxicology at Wright State University in Dayton, Ohio, is not surprised Cox found BMAA everywhere.

"Cyanobacterias produce dozens of bioactive properties," he said. It's quite possible that if you look, you'll find other toxins across the board, he said.

He added that what happened in Guam was a unique situation, and "it does not mean its widespread occurrence is a general risk to humans. There needs to be a unique set of circumstances to allow for high enough concentrations."

Others question Cox's link between BMAA and neurodegeneration.

"The data are remarkably thin," said Christopher Shaw, a professor of ophthalmology and neuroscience at the University of British Columbia. "They make huge scientific leaps based on thin data."

Shaw said it's possible that Cox's research is not picking up BMAA in diseased brains, but rather a similar substance that is produced in the brain as the result. He noted that there are a vast number of biochemical abnormalities in the brains of people with ALS, Parkinson's and Alzheimer's. In any case, BMAA is an extremely weak neurotoxin, he said.

However, if Cox is right, he said, his findings will have to be reproduced by others.

One group of researchers claims to have done that.

Scientists at the University of Miami have been studying the brains of ALS and Alzheimer's patients from Florida and other places in the United States.

"We are finding it (BMAA)," said Deborah Mash, a professor of neurology at the University of Miami and director of the Brain Endowment Bank. Mash said BMAA has showed up in all of the brain samples from ALS and Alzheimer's patients that have been tested by her lab. That research has not been published yet and the actual number of samples was not available, she said.

Mash did say, however that only one of 10 brain samples she examined from patients who did not have brain disease tested positive for the amino acid, she said. And that so far, between 40 and 50 brain samples from patients with brain diseases have tested positive for BMAA among all the labs that are looking for it worldwide.

However, to definitively establish the link between BMAA and brain disease, scientists will have to find it in thousands of samples, she said.

"Here you have this cyanobacteria that's ubiquitous, that's in lakes, that could be moving up the food chain," she said. "Whether or not it's a major environmental toxin remains to be seen.

"But the story makes sense to me."

From the April 5, 2005, editions of the Milwaukee Journal Sentinel

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