Trends in Applied Sciences Research

ISSN 1819-3579

Academic
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Vitamins Identified as Key Nutrient Which May Promote Harmful Algal Blooms in Coastal Waters

Harmful algal blooms, which negatively affect coastal ecosystems, public health, economies and fisheries around the world, may be promoted by vitamins B-1 and B-12 according to Stony Brook University scientists, whose findings were published in an early online edition (Nov. 10) and in the current issue (Nov. 30) of Proceedings of the National Academy of Sciences (PNAS).

Professor Christopher J. Gobler, Ph.D., Research Scientist Ying Zhong Tang, and Ph.D. candidate Florian Koch of the School of Marine and Atmospheric Sciences at Stony Brook conducted experiments to evaluate whether the species of phytoplankton which form Harmful Algal Blooms (HAB's) require B-vitamins to grow. Harmful algal blooms are caused by phytoplankton and have a negative impact on coastal ecosystems and fisheries world-wide and cost the U.S. economy alone hundreds of millions of dollars annually. The impacts of harmful algal blooms have intensified in recent decades and most research has focused on chemical nutrients such as nitrogen and phosphorus as causative agents of these blooms. Vitamins have not been considered as prime suspects since prior investigations suggested that only small portion of phytoplankton species require B-vitamins for growth.

"Harmful algal blooms are not a new phenomenon, although many people may know them by other names such as red tides or brown tides," Dr. Gobler said. "These events can harm humans by causing poisoning from shellfish contaminated with algal toxins and can damage marine ecosystems by killing fish and other marine life. The distribution, frequency and intensity of these events have increased across the globe and scientists have been struggling to determine why this is happening."

Every coastal state in the United States experiences harmful algal blooms, according to Dr. Gobler.

While previous studies have examined the role of nutrients in harmful algal blooms, "the importance of coenzymes and particularly vitamins (vitamins B-1, B-7 and B-12) in regulating and stimulating harmful algal blooms has rarely been considered," the researchers wrote.

"New methods have recently been developed to measure concentrations of vitamins B-1 and B-12 in the ocean and we discovered that vitamin levels were co-varying with the occurrence of HABs," Dr. Gobler said.

The researchers examined more than 40 harmful algal bloom species in the laboratory and reported that all but one of the species tested (96%) required vitamin B-12 and that 20 of 27 species (74%) required vitamin B-1. In addition, the concentrations of vitamins B-1 and B-12 needed by the toxic algae were higher than those previously reported for other phytoplankton. The concentrations measured as needed for growth in the lab correspond closely to vitamin concentrations reported in coastal waters, suggesting that HAB demands for vitamins may exhaust the available supply of vitamins in hours to days. These findings demonstrate the potentially significant ecological role of B-vitamins in regulating the dynamics of HAB's, the authors wrote.

The larger than expected vitamin requirements of harmful algal blooms partly stems from the fact that most of these events are caused by a class of algae called dinoflagellates. Dinoflagellates often consume large organic molecules such as amino acids and proteins that are similar to vitamins. The authors wrote "vitamins are among a suite of organic compounds dinoflagellates exploit for growth. Since dinoflagellates are notorious for the ability to form HAB's, this study suggests vitamins are key organic compounds that may influence the occurrence of HAB's of dinoflagellates."

Harmful algal blooms have had a devastating impact many fisheries and ecosystems and there is great interest in curtailing these events. However, discovering the most important source of vitamins to HAB's may prove challenging. Dr. Gobler said. "There are a lot of efforts right now to protect coastal ecosystems against HAB's. Many efforts have been made to curb nitrogen loads since this nutrient has been considered the primary chemical promoting these events. This study demonstrates that vitamins must also be considered in order to understand the dynamics of HAB's." While the sources of nitrogen to coastal waters are well known, Dr. Gobler notes that, "we now need to identify the major sources vitamins promoting harmful algal blooms."

Story Source: The above story is reprinted (with editorial adaptations by ScienceDaily staff) from materials provided by Stony Brook University.