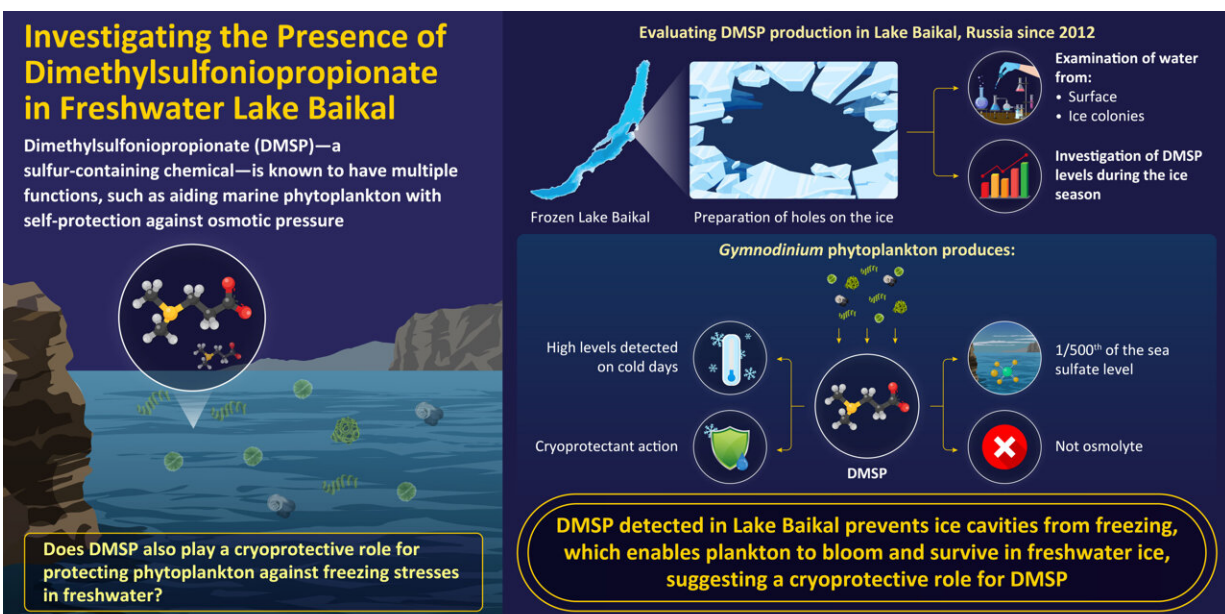


Study reveals freshwater phytoplankton in Lake Baikal produce sulfur-containing chemical to survive in ice

January 11 2024



Abundant production of dimethylsulfoniopropionate as a cryoprotectant by freshwater phytoplanktonic dinoflagellates in ice-covered Lake Baikal
 Toda et al. (2023) | *Communications Biology* | DOI: 10.1038/s42003-023-05573-9



Credit: *Communications Biology* (2023). DOI: 10.1038/s42003-023-05573-9

Dimethylsulfoniopropionate (DMSP) is a compound synthesized by marine phytoplankton for protection against the osmotic pressure of saline water. However, DMSP could also have a role in preventing freezing damage.

Now, in a new study, a group of researchers surveyed Lake Baikal every spring for almost a decade and discovered that freshwater plankton *Gymnodinium*, which does not need osmotic regulation, produces DMSP as a protective measure against freezing temperatures, suggesting a cryoprotective role of DMSP.

Researchers from Kumamoto University have found that DMSP, a sulfur-containing organic molecule, was produced by freshwater [phytoplankton](#) in colder days to help with survival in ice water. Their results revealed a cryoprotectant role for DMSP.

Phytoplankton or microalgae found in the ocean are often known to produce the sulfur-containing chemical DMSP. This [organic molecule](#) breaks down to release a strong but sweet-smelling gas called dimethyl sulfide (DMS), which plays a major role in the formation of cloud condensation nuclei and is also associated with the smell of the sea. More importantly, DMSP acts as an osmolyte and thus protects the phytoplankton against the osmotic pressure created by saline water.

Scientists have, however, hypothesized that zwitterionic DMSP—an ion containing both positive and negatively charged [functional groups](#)—must also have a role beyond osmotic regulation. Past studies have shown that [marine algae](#) in colder oceans produces more DMSP than those found in warmer oceans. In addition, studies have also revealed that the concentration of DMSP in the ocean decreases as the seasonal temperature rises.

Conversely, the abundance of DMSP increases at low temperatures. This could mean that DMSP plays a cryoprotective role for the survival of plankton. In other words, it can act as a substance that protects biological material from damage on being exposed to stresses such as freezing temperatures.

Wanting to decipher the cryoprotective role of DMSP for marine algae, a team of researchers from Kumamoto University and Limnological Institute, Russian Academy of Sciences, led by Professor Kei Toda investigated the presence of DMSP in Lake Baikal in Russia, the world's clearest freshwater lake. Since 2012, the team has been tracking seasonal variations in phytoplankton and DMSP concentration in the ice-covered Lake Baikal.

The results of this decade-long study were recently [published](#) in *Communications Biology* on 24 November 2023. "During one of our previous studies, local people reported DMS-like odors from the lake during the ice-melting season. Pollution was an unlikely source, so the other factor could be the conversion of DMSP by the phytoplankton to DMS. Since freshwater algae do not need osmolytes like their marine counterparts do, this piqued our interest to explore its role further," says Prof. Toda.

The team conducted eight expeditions to the Baikal Lake since 2012 to search for phytoplankton production and analyzing DMSP and related chemicals. To analyze DMSP levels, the researchers dug two ice holes of about 70 cm in diameter in the lake during the spring season (around March). They obtained water samples daily from the surface of the lake and from within the ice colonies where the phytoplankton *Gymnodinium baicalense* bloomed during spring.

The team found that the *Gymnodinium* in the ice colonies produced DMSP and released it into the water during the ice-melting season. Their analysis showed that DMSP concentrations were higher on cold days and lower when temperatures were higher than the freezing point.

Phytoplankton use the sulfur atom from the sulfate ions present in seawater to produce DMSP. The results of this study showed that despite the sulfate concentration in Lake Baikal being 1/500th of the

concentration found in seawater, the freshwater plankton *Gymnodinium* effectively used their limited sulfur resource to synthesize DMSP in their cells and survived in freshwater ice.

The observations and the analysis carried out since 2012 validated the role of DMSP as a cryoprotectant for freshwater algae. "Our results can be further verified by culture experiments at different temperatures and by identifying the genes responsible for DMSP production by freshwater algae," says Prof. Toda.

While the production of DMSP by marine plankton for coping with osmotic pressure was known, this study is the first to confirm the production of DMSP by freshwater plankton, which do not require osmotic adjustments.

More information: Kei Toda et al, Abundant production of dimethylsulfoniopropionate as a cryoprotectant by freshwater phytoplanktonic dinoflagellates in ice-covered Lake Baikal, *Communications Biology* (2023). [DOI: 10.1038/s42003-023-05573-9](https://doi.org/10.1038/s42003-023-05573-9)

Provided by Kumamoto University

Citation: Study reveals freshwater phytoplankton in Lake Baikal produce sulfur-containing chemical to survive in ice (2024, January 11) retrieved 27 April 2024 from <https://phys.org/news/2024-01-reveals-freshwater-phytoplankton-lake-baikal.html>

This document is subject to copyright. Apart from any fair dealing for the purpose of private study or research, no part may be reproduced without the written permission. The content is provided for information purposes only.