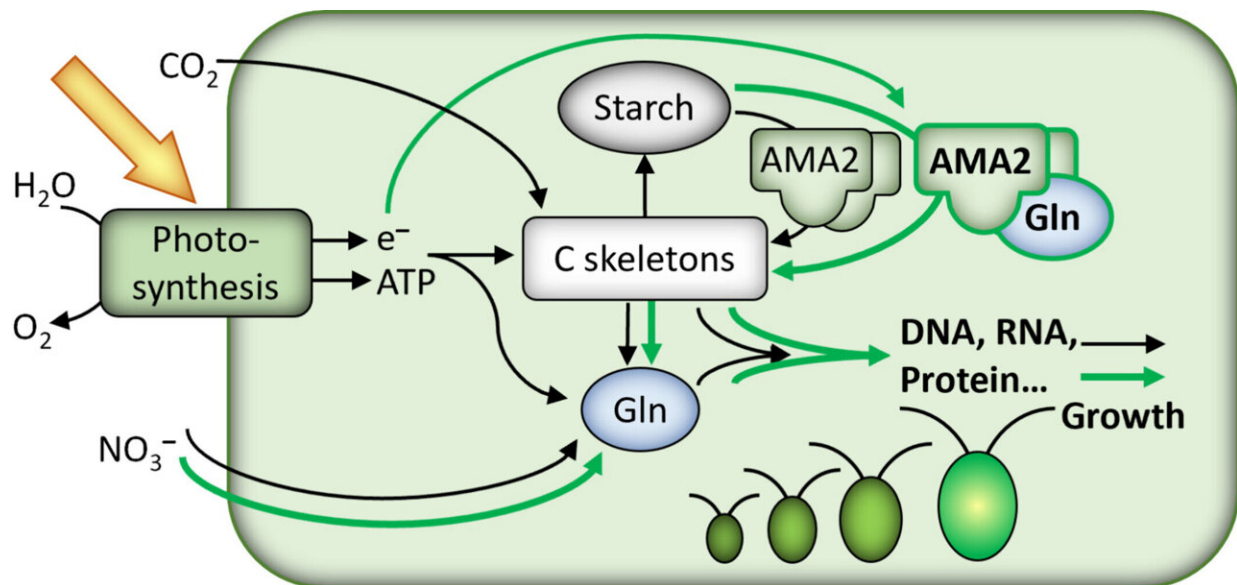


How a biocatalyst might boost the growth of microalgae

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Schematic model of how the activating effect Gln exerts on AMA2 activity might allow a direct crosstalk between C and N metabolism to optimize cell growth. Photosynthesis provides energy (ATP) and reductant (e^-) to assimilate inorganic nutrients (only CO_2 and nitrate [NO_3^-] are shown). Credit: *Plant Direct* (2024). DOI: 10.1002/pld3.609

Living organisms consist to a large extent of carbon (C) and nitrogen (N) compounds. These have to be taken in with food or, in the case of plants, produced through photosynthesis.

A previously mysterious extension of a starch-degrading enzyme in algae could be a kind of sensor to determine how much nitrogen is currently available. If there is plenty of it, the [algal cells](#) quickly release many building blocks for their growth.

The research team led by Dr. Anja Hemschemeier and Dr. Lisa Scholtysek from the Photobiotechnology Group at Ruhr University Bochum, Germany, report their [new findings](#) in the journal *Plant Direct*.

A starch-degrading biocatalyst as a nitrogen sensor

The optimal composition of a living cell is made up of a certain ratio of C and N, but the quantities of these elements in our diet and in the environment of plants and algae are usually not that perfectly balanced. Therefore, living organisms must tune their metabolism and [chemical composition](#) to the availability of these—and other—chemical building blocks.

In plant-like organisms, C-containing molecules that are not immediately utilized are stored as starch. Various types of biocatalysts—also termed enzymes—release C skeletons from starch when they are needed as building blocks or as energy source. One of these enzymes is alpha-amylase, which Hemschemeier's research team investigated from the microalga *Chlamydomonas reinhardtii*.

In the process, the team made a surprising discovery. "The enzyme has an extension that is not needed for starch degradation," explains Hemschemeier, who headed the study. "This protein part has already been discovered in a similar form in many different enzymes, where it usually regulates the function of the biocatalyst.

"Commonly, this protein part senses small compounds that play a role in the corresponding metabolic pathway, so that its speed can be adjusted

and coordinated with other pathways."



Anja Hemschemeier is investigating the detailed processes that take place in algae. Credit: RUB, Marquard

Lisa Scholtysek, lead author of the study, tested the effect of many different substances on the activity of this amylase. Finally, she identified one that noticeably increased the activity of the enzyme, namely the amino acid glutamine.

This N-containing compound is a building block of proteins. In many organisms, glutamine is also the first product of N assimilation and serves both as the primary N source and as a signal for how much N is

available for biosynthetic pathways.

An alpha-amylase as growth booster?

To date, this combination of starch-degrading [enzyme](#) and glutamine sensor has not been described in literature. Still, based on bioinformatic analyses conducted by the researchers, many microalgae appear to possess this specific combination.

"Our research is still in its infancy," says Hemschemeier. "So far, we have studied this effect only at the level of the isolated biocatalyst from *Chlamydomonas*. An important next step is to study it in living algae."

However, the researchers have a hypothesis. "It is conceivable that this alpha-amylase registers when a lot of nitrogen is present. Then, it accelerates the release of C scaffolds from starch for the production of N- and C-containing cell components." This could optimize cell growth when the algae encounter optimal conditions.

More information: Lisa Scholtysek et al, The activation of *Chlamydomonas reinhardtii* alpha amylase 2 by glutamine requires its N-terminal aspartate kinase–chorismate mutase–tyrA (ACT) domain, *Plant Direct* (2024). [DOI: 10.1002/pld3.609](https://doi.org/10.1002/pld3.609)

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