Researchers decipher the molecular basis of blue-green algae

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Under normal conditions, cyanobacteria, also termed blue-green algae, build up energy reserves that allow them to survive under stress such as long periods of darkness. They do this by means of a molecular switch in an enzyme. By removing this switch, it should be possible to use the excess energy of the bacteria for biotechnological purposes such as hydrogen production, without the bacteria suffering.

This was found out by researchers at the Ruhr-Universität led by Prof. Dr. Matthias Rögner (Biochemistry of Plants, Faculty of Biology and Biotechnology). Their results, which they obtained together with a Japanese research group from the Tokyo Institute of Technology, are published in the *Journal of Biological Chemistry*.

Molecular switch prevents waste of energy

The energy-rich molecule ATP serves as a store for the energy gained through photosynthesis in plants. It is built up, and where necessary broken down again, by the enzyme ATPase. To guard the bacterium against stress situations with too much or too little light, the ATPase of the cyanobacteria has a small area which acts like a switch. It prevents the ATP from being broken down prematurely in the dark, when no photosynthesis takes place. The bacterium thus creates a store of energy which helps it through stress phases. However, this switch also slows the rate of photosynthetic electron transport with the water splitting in light: "You have to imagine it like wanting to squeeze something into a full storehouse against resistance", says Prof. Rögner.

On the way to biotechnological hydrogen

In the experiment, he and his colleagues removed the switch area of the ATPase in cyanobacteria by means of genetic engineering. "Of course we expected that the bacteria would suffer much more afterwards and that they would become much slower", he explains. "But that was not the case". The bacteria grew just as usual under laboratory conditions - without light stress. However, they create lower ATP energy reserves, so they can't survive very long dark periods as well as the wild type. On the other hand, the excess energy in light, which otherwise went into the reserves, is now available for biotechnological use. "This should make it possible to use at least 50% of the energy gained from light-driven water splitting for other processes in the future, e.g. for solar-powered biological hydrogen production through cyanobacterial mass cultures in photobioreactors", estimates Prof. Roegner.

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