Optogenetics: A novel light sensor built from algal enzymes

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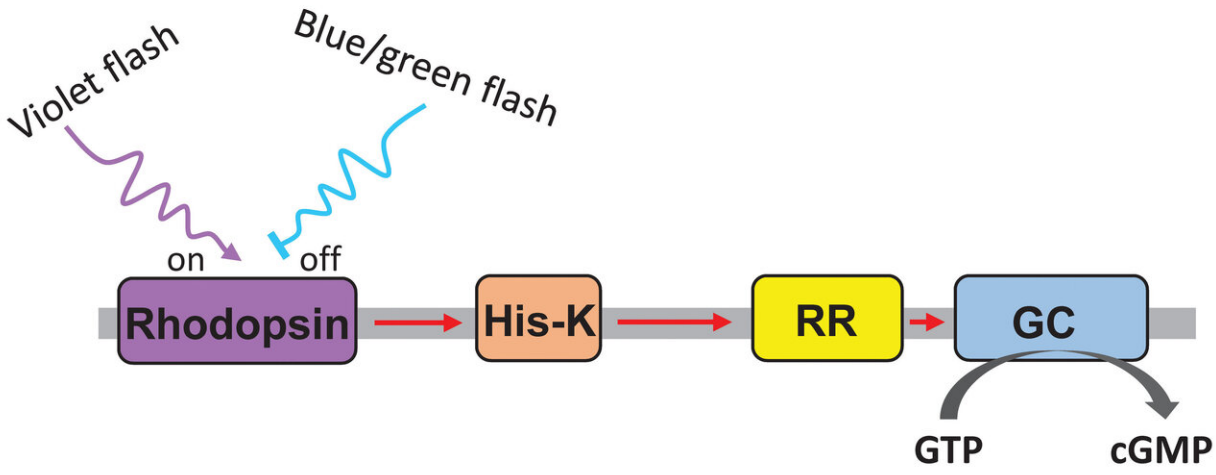

Violet light triggers a signalling chain in the light sensor protein switch-Cyclop, blue or green light stops the chain. At the end, the production of the signalling molecule cGMP is regulated by the enzyme guanylyl cyclase (GC). Credit: Shiqiang Gao / University of Würzburg

The unicellular green alga Chlamydomonas reinhardtii has already given research a massive boost: One of its light sensors, channelrhodopsin-2, founded the success of optogenetics about 20 years ago.

In this technology, the alga's light sensor is incorporated into cells or small living organisms such as threadworms. Afterwards, certain

physiological processes can be triggered or stopped by light. This has already led to several new scientific findings, for example on the function of nerve cells.

Now the green alga Chlamydomonas is once again setting an accent. Once again, it is its light sensors, the rhodopsins, that have added an instrument to the toolbox of cell biology.

Light sensor produces the messenger cGMP

Researchers Yuehui Tian, Georg Nagel and Shiqiang Gao from Julius-Maximilians-Universität (JMU) Würzburg in Bavaria, Germany, have constructed a novel light sensor from two of the algae's rhodopsins. It has enzymatic activity and can be switched by two different light colors. UV or violet light leads to the production of cGMP, an important signaling molecule in the cell. A blue or green flash of light, on the other hand, stops the production of the signaling molecule.

The researchers present the new light sensor in the journal *BMC Biology*. They have given it the name switch-Cyclop.

Nagel's research group at the JMU Institute of Physiology is continuing to characterize the properties of the various rhodopsins from Chlamydomonas. The professor's team is cooperating closely with neuroscientists. The goal is to explore the possible applications of the light sensors.

More information: Yuehui Tian et al. An engineered membrane-bound guanylyl cyclase with light-switchable activity, *BMC Biology* (2021). DOI: 10.1186/s12915-021-00978-6

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