Light-sensitive protein from a fungus expands the optogenetic toolkit

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Optogenetics is a quickly expanding field of research which has revolutionized neurobiological and cellbiological research around the world. It uses natural or tailored light-sensitive proteins in order to switch nerve cells on and off without electrodes with unprecedented accuracy in respect to time and location. The discovery of the light-gated ion channel channelrhodopsin in algae in 2002 was a key finding for this field. In 2005, Frankfurt scientists working with Prof. Alexander Gottschalk succeeded in transferring the protein to the translucent nematode C. elegans in order to control its movements with light. Together with the lab of Georg Nagel at the University of Würzburg, Gottschalk has now added another tool to the optogenetics toolbox: The protein 'CyclOp' from the aquatic fungus blastocladiella emersonii.

As the research group under Prof. Alexander Gottschalk reports in the current edition of the journal *Nature Communications*, the CyclOp produces the second messenger cGMP when exposed to light. This important cellular signal is involved in vision, regulating blood pressure, induced cell death and also male erection. The compound Viagra, for example, leads to an increase in the cGMP level in the cells. If CyclOp is introduced to an organism like the nematode Caenorhabditis elegans, then one can specifically study cGMP-dependent signal pathways within the cell. This allows optogenetics to go a step beyond previous research.

"The light-activated enzyme CyclOp has outstanding molecular properties which qualify it as a valuable addition to the optogenetics toolbox for cell biologists and neurobiologists", explains Prof. Gottschalk from the Buchmann Institute for Molecular Life Sciences (BMLS) at Goethe University. His research group has introduced the protein into oxygen sensing cells in order to find out what role the second messenger cGMP plays in these cells. To do so, the translucent nematode is exposed to light leading to intracellular generation of cGMP. The cells respond by acting as if they had detected an increase in the oxygen level. In this way the researchers can use CyclOp to get a better understanding of how the natural signal for these cells is turned into a cellular response.

More information: "Optogenetic manipulation of cGMP in cells and animals by the tightly light-regulated guanylyl-cyclase opsin," CyclOp. *Nature Communications* (8. September 2015), DOI: 10.1038/NCOMMS9046

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