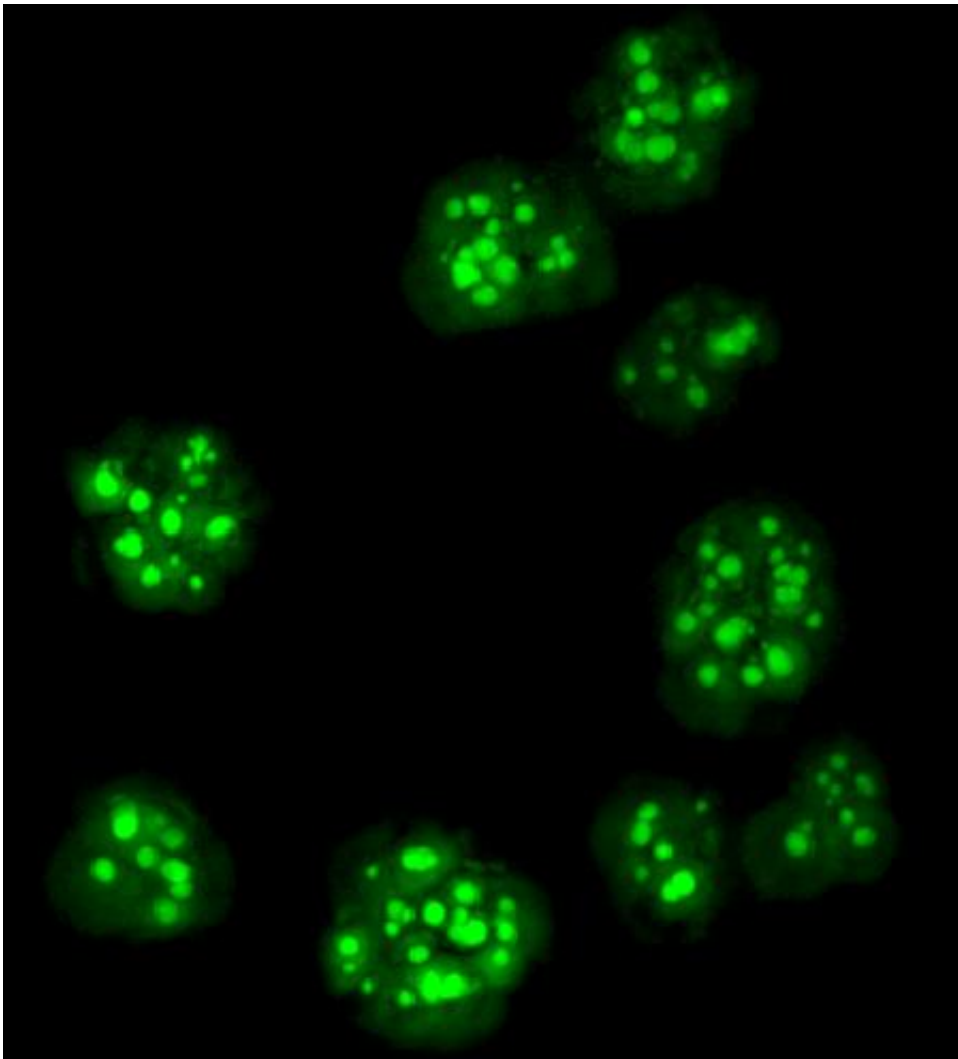


Algae discovery offers potential for sustainable biofuels

October 19 2016



Fluorescence micrograph of vip1-1 cells from the alga *Chlamydomonas* filled with oil droplets that are colored bright green. Credit: Inmaculada Couso, Ph.D., and James Umen, Ph.D., Donald Danforth Plant Science Center

James Umen, Ph.D., associate member at Donald Danforth Plant Science Center, and colleagues have discovered a way to make algae better oil producers without sacrificing growth. The findings were published September 6, in a paper titled, "Synergism between inositol polyphosphates and TOR kinase signaling in nutrient sensing, growth control and lipid metabolism in *Chlamydomonas*," in *The Plant Cell*. Umen and his team including lead author Inmaculada Couso, Ph.D., and collaborators Bradley Evans Ph.D., director, Proteomics & Mass Spectrometry and Doug Allen, Ph.D., USDA Research Scientist at the Danforth Center identified a mutation in the green alga *Chlamydomonas* which substantially removes a constraint that is widely observed in microalgae where the highest yields of oil can only be obtained from starving cultures.

Umen and his team found the oil-accumulating mutation in *Chlamydomonas*, called *vip1-1*, while investigating how two conserved signaling systems interact with one another. One system involves a protein called TOR (target of rapamycin) whose activity is tuned to match cell growth rate with nutrient levels in the environment. The other system involves a family of proteins called VIP that produce highly phosphorylated small molecules called inositol polyphosphates that are thought to act as intracellular signals, but whose function in algae is not well-defined. The team found that when VIP activity was reduced by the *vip1-1* mutation, cell growth became extremely sensitized to changes in TOR activity; but unexpectedly, this sensitivity was dependent on the sources of carbon nutrients that cells had available. When TOR-inhibited *vip1-1* cells were given light for photosynthesis and supplemented with acetate—a "free" source of extra carbon—their growth was completely arrested. However, the *vip1-1* mutation had no impact on TOR-inhibited cell growth when acetate was removed and atmospheric CO₂ was the only carbon source.

The connection between acetate and the growth behavior of *vip1-1* cells

led Umen and his team to investigate the mutant further to see if it had other metabolic alterations that could be detected without perturbing TOR signaling. Remarkably, they found that actively growing *vip1* cells were oil overaccumulators that made extra storage oil compared to normal cells, and did so without incurring a significant growth penalty. Moreover, under starvation conditions when normal cells boost their oil content significantly, *vip1-1* cells increased it even more with up to double the yields seen in normal cells.

"Our study reveals a new way to understand how cells control carbon metabolism and storage," said Inmaculada Couso, Ph.D., post-doctoral researcher, Institute of Plant Biochemistry and Photosynthesis. "As we decipher the inositol polyphosphate signaling code, we open up the prospect of being able to reprogram metabolism and make algae better producers of oil or other high value carbon-rich compounds."

More information: Synergism between inositol polyphosphates and TOR kinase signaling in nutrient sensing, growth control and lipid metabolism in *Chlamydomonas* Advance Publication September 6, 2016, doi: [dx.doi.org/10.1105/tpc.16.00351](https://doi.org/10.1105/tpc.16.00351) , [www.plantcell.org/content/early ... pc.16.00351.abstract](http://www.plantcell.org/content/early/2016/09/06/pc.16.00351.abstract)

Provided by Donald Danforth Plant Science Center

Citation: Algae discovery offers potential for sustainable biofuels (2016, October 19) retrieved 28 April 2024 from <https://phys.org/news/2016-10-algae-discovery-potential-sustainable-biofuels.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.