# Combined nitrogen limitation and peroxide treatment enhances neutral lipid accumulation in the marine diatom *Phaeodactylum tricornutum*

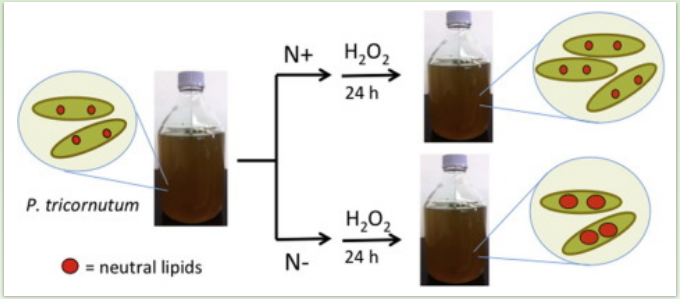
Andrew R. Burch and Annaliese K. Franz*

Department of Chemistry, University of California, Davis

UC DAVIS DEPARTMENT OF CHEMISTRY

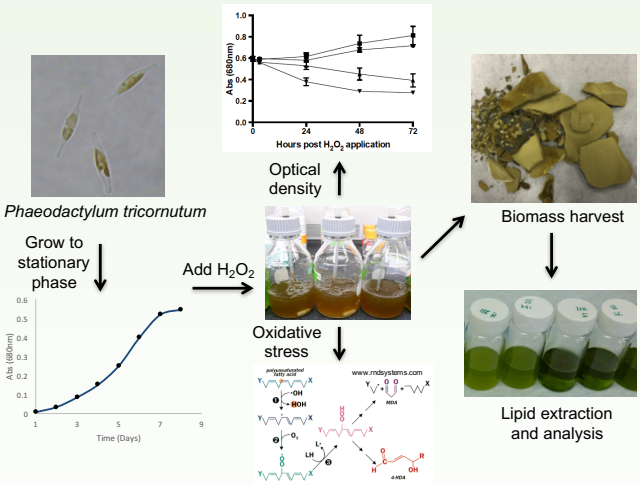
## Rationale for exploring alternative stress treatments to increase microalgae lipid productivity

Making algae-derived biofuels economically competitive with fossil fuel requires the development of conditions that enhance lipid production in candidate microalgae species. Stress treatment is an effective strategy to enhance microalgae lipid production but often results in lower growth rates and decreased biomass productivity. This study describes the potential of using hydrogen peroxide ($H_2O_2$) as a late-stage treatment to increase neutral lipid yields in nitrogen-limited *Phaeodactylum tricornutum* cultures (Burch and Franz, *Bioresource Technology, 2016).*



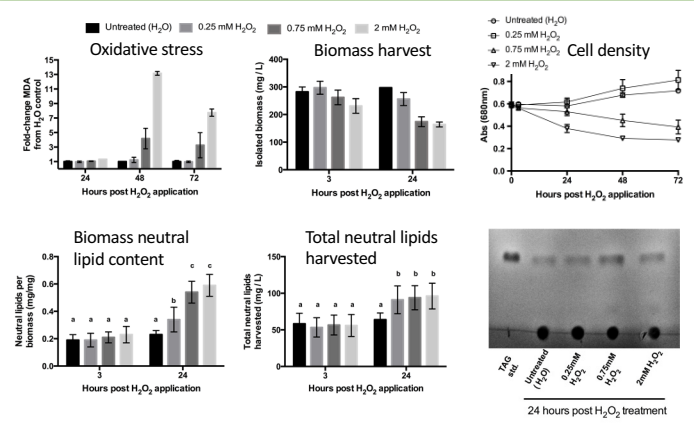

## Materials and Methods

Experimental design – *P. tricornutum* hydrogen peroxide treatment




- Lipids were extracted from harvested biomass using a modified Folch method and neutral lipids were quantified using a bleach-enhanced Nile-Red microplate lipid extract assay (Higgins et al., 2014).
- Hydrogen peroxide treatment during nitrogen or phosphate limitation was also investigated to determine the influence of nutrients on $H_2O_2$-induced neutral lipid accumulation.

## Oxidative stress as a mediator for lipid accumulation




The neutral lipid content of *P. tricornutum* increased over 2-fold and and the amount of neutral lipids harvested per liter culture increased up to 50% following a 24-hour $H_2O_2$ treatment period.

Potential mechanisms of $H_2O_2$-induced neutral lipid production in *P. tricornutum*

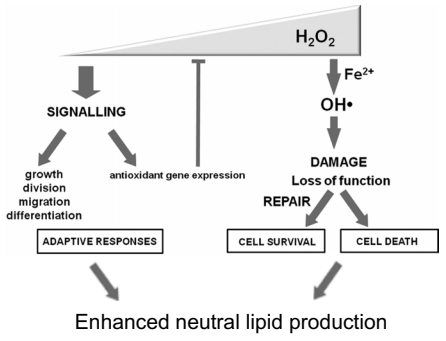
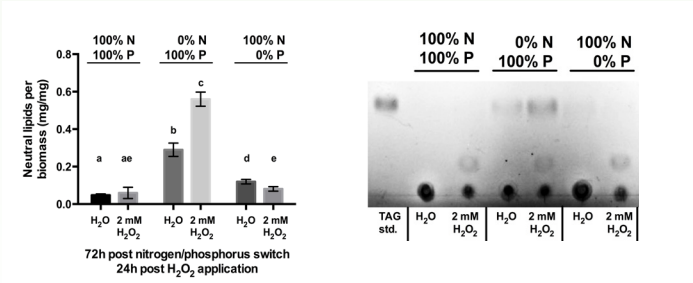



Image modified from Veal et al., 2014.




Nitrogen limitation, but not phosphate limitation has a significant effect on neutral lipid production 24 hours after $H_2O_2$ application.

## Acknowledgments

This work was supported by a National Science Foundation Chemical, Bioengineering, Environmental, and Transport Systems (NSF-CBET) Award under Grant No. 1512250. Other sources of funding were provided by the UC Davis Biochemistry, Molecular, Cellular and Developmental Biology (BMCDB) graduate group. ARB received a Mary Rosenthal Memorial Student Travel Grant Algae Biomass Travel Grant Award from the Algae Foundation to attend and present at the 2016 Algae Biomass Summit in Phoenix, Arizona. ARB and AKF also acknowledge Dr. Edward Balmond, Dr. Brendan Higgins, Julia Jennings and Cody Yothers (UCD) for their help throughout the study.