SCIENTIFIC SUMMARY ABOUT THE PROJECT :

# Analysing physiological stress in motile phytoplankton

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Microalgae are unicellular, eukaryote organisms found in nearly all aquatic systems of the world. Even though they are very small they have a great impact on the ecosystem of the world. A large amount of the oxygen in the atmosphere is produced by those organisms. Further they are trade as promising alternative for food [4], feed, cosmetics [1] and renewable energy source due to their fast growth and lipid production [5].

Lipids function as structural component of eukarotic cell membrane. They modulate cellular acitvities and they serve as energy storage compounds in cells [2]. It has been shown that if microalges are exposed to stress conditions (e.g. nutrient depletion, high light irradiation, salinity [3]) the cells reduce growth and even stop dividing [2]. Further they stop the synthesis of polar lipids for structural membranes and begin to accumulate oil in the form of cytoplasmic lipid droplets [2].

The Project showed the growth curve dependent accumulation of cytoplasmic lipid droplets in the microalgae raphidophytes *Heterosigma akashiwo* (strain CCMP452, from hereafter referred to HA452). The cells experienced no other physiological stresses then the emerging nutrient limitation due to cell culture growth in the culture tubes.

Cells were stained with Nile Red (Thermo Fisher Scientific), a red fluorescence lipids stain (excitation/ emission 552/636nm) that stains neutral lipid droplets within cells. Epifluorescence microscopy was used to identify the size and location of neutral lipid droplets within the cells.

HA452 is a marine, mixotrophic organism capable of photosynthesis and ingestion of bacteria [7]. They are highly motile which allows them to undertake diel vertical migrations in order to reach well-lit surface water during the day and deeper nurient-rich layers at night [6].

For the orientation during their diel migration HA452 are using gravitaxis, which is characterized by the directional movement of an organism which depends on gravity [6]. Gravitaxis is a purely physical mechanism in HA452 since their vertical swimming direction is biased due to a stabilizing torque of the cell [6]. This stabilizing torque is influenced by the asymmetry in shape and the mass distribution inside the cell. It was recently shown that HA452 can diversify their migration strategy in response to turbulent cues [6], which indicates that the cells can actively modulate gravitaxis.

Lipids have a smaller density than the cytoplasm, the organelles or the nucleus. The location of this lipid droplets therefore influences the mass distribution of the cell, which has an influence on the stabilizing torque and hence the gravitaxis of the cell. This influence of the lipids on the cell stability was never considered until now.

The project shows growth curve dependent changes in location and size of lipid droplets for HA452. Further the influence of the lipids on the rotational stability and hence on the gravitaxis of the cell was discussed. Cell stability simulation experiments will be carried out as continuative research project, in order to quantify the influence of the lipids,.

# References


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