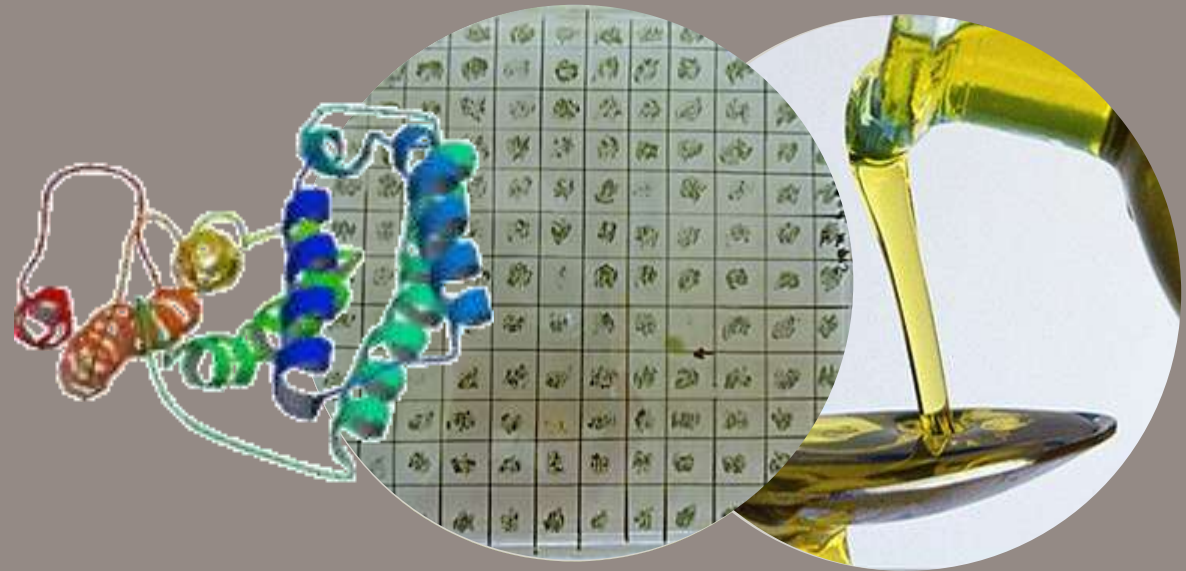


Superior TAG accumulation in starchless mutants of *Scenedesmus obliquus*

Algae Biomass Summit 2014, San Diego
October 1st, Lenny de Jaeger



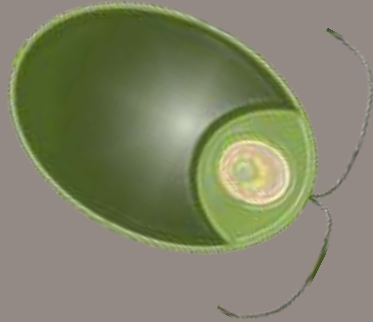
5000 B.C.



Corn Productivity



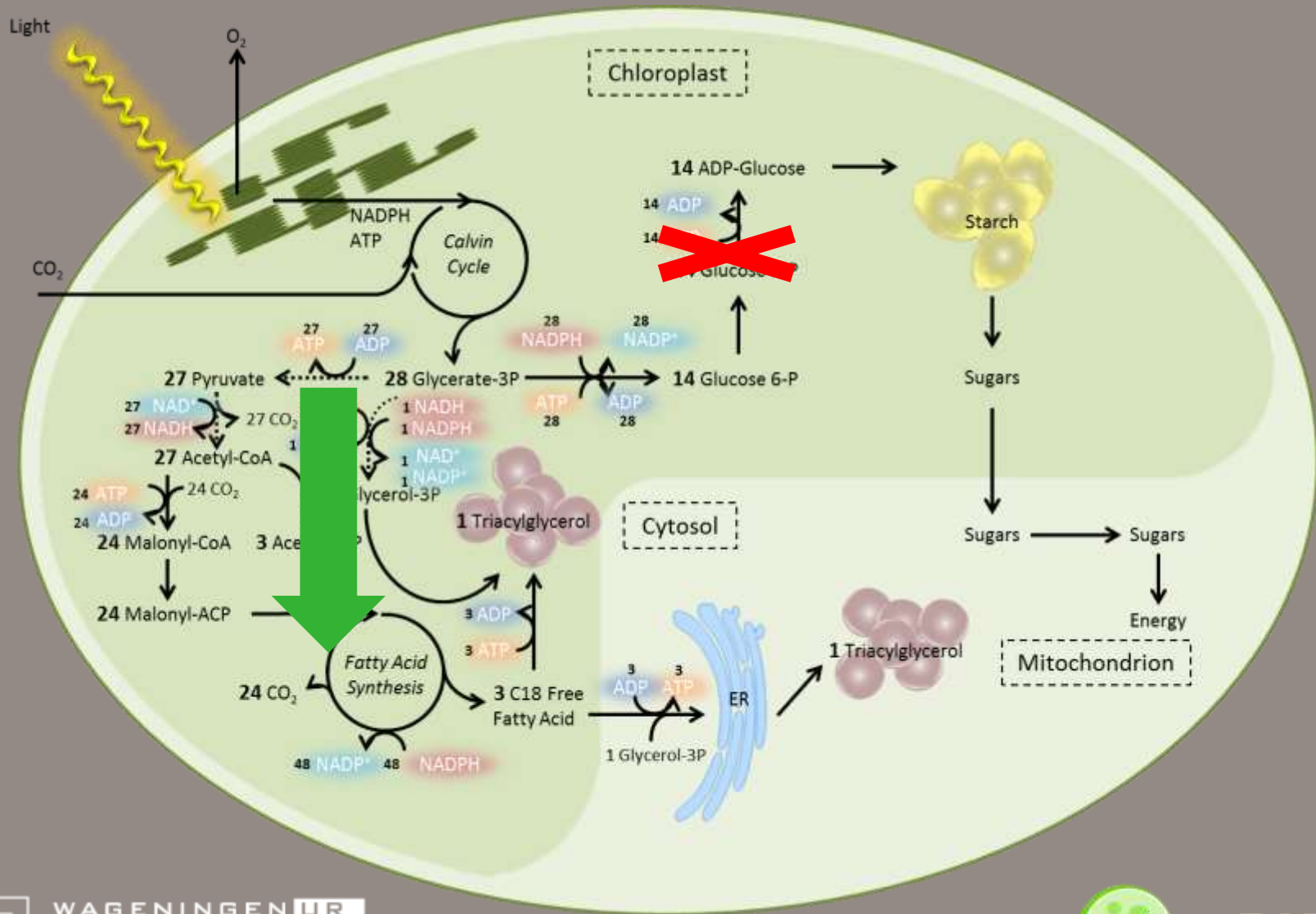
Microalgal Productivity



WAGENINGEN UR
For quality of life



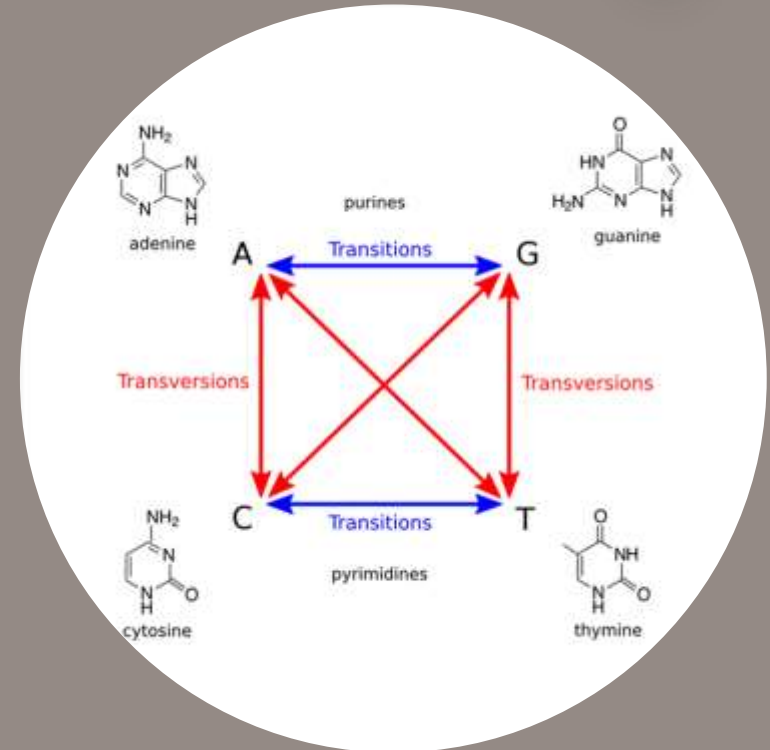
Carbon partitioning



Mutagenesis



- UV induces transversions,
 - Enzyme function reduced
 - STOP introduced
- UV mutagenesis widely used
- Not considered as GMO
- A lot of screening
- Stability



Increased Lipid Accumulation in the *Chlamydomonas reinhardtii* *sta7-10* Starchless Isoamylase Mutant and Increased Carbohydrate Synthesis in Complemented Strains[∇]

Victoria H. Work,¹ Randor Radakovits,² Robert E. Jinkerson,² Jonathan E. Meuser,¹
Lee G. Elliott,¹ David J. Vinyard,³ Lieve M. L. Laurens,⁴
G. Charles Dismukes,³ and Matthew C. Posewitz^{2*}

¹Division of Environmental Science and Engineering, Caltech, Pasadena, California 91125, ²Department of Chemical Engineering, Caltech, Pasadena, California 91125, ³Department of Chemistry, Caltech, Pasadena, California 91125, ⁴Department of Plant and Environmental Science, Wageningen University, Wageningen, The Netherlands

ARTICLE

BIOTECHNOLOGY
and
BIOENGINEERING

Inhibition of Starch Synthesis Results in Overproduction of Lipids in *Chlamydomonas reinhardtii*

Siaut et al. *BMC Biotechnology* 2011, **11**:7
<http://www.biomedcentral.com/1472-6750/11/7>



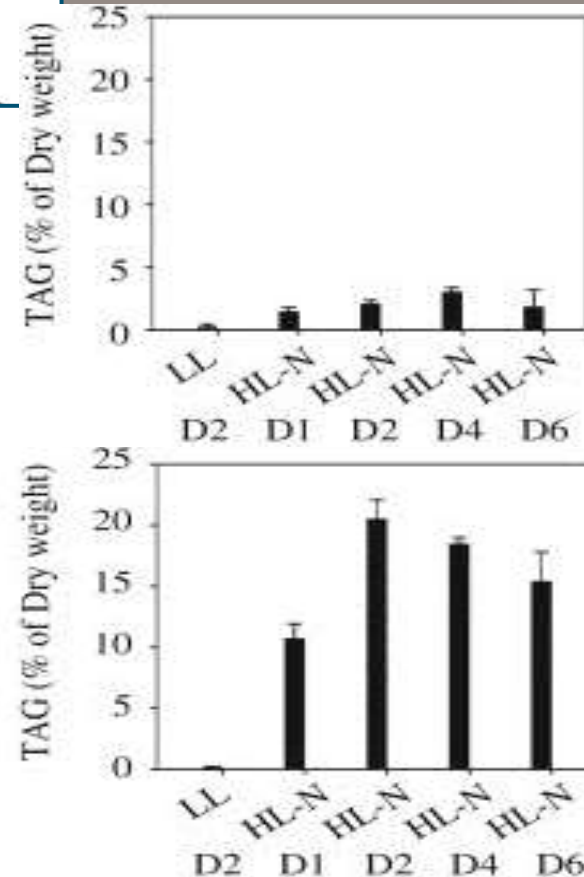
RESEARCH ARTICLE

Open Access

Oil accumulation in the model green alga *Chlamydomonas reinhardtii*: characterization, variability between common laboratory strains and relationship with starch reserves

Magali Siaut^{1,2,3,4}, Stéphan Cuiñé^{1,2,3}, Caroline Cagnon^{1,2,3}, Boris Fessler^{1,2,3}, Mai Nguyen^{1,2,3}, Patrick Carrier^{1,2,3}, Audrey Beyly^{1,2,3}, Fred Beisson^{1,2,3}, Christian Triantaphyllidès^{1,2,3}, Yonghua Li-Beisson^{1,2,3*}, Gilles Peltier^{1,2,3}

Abstract

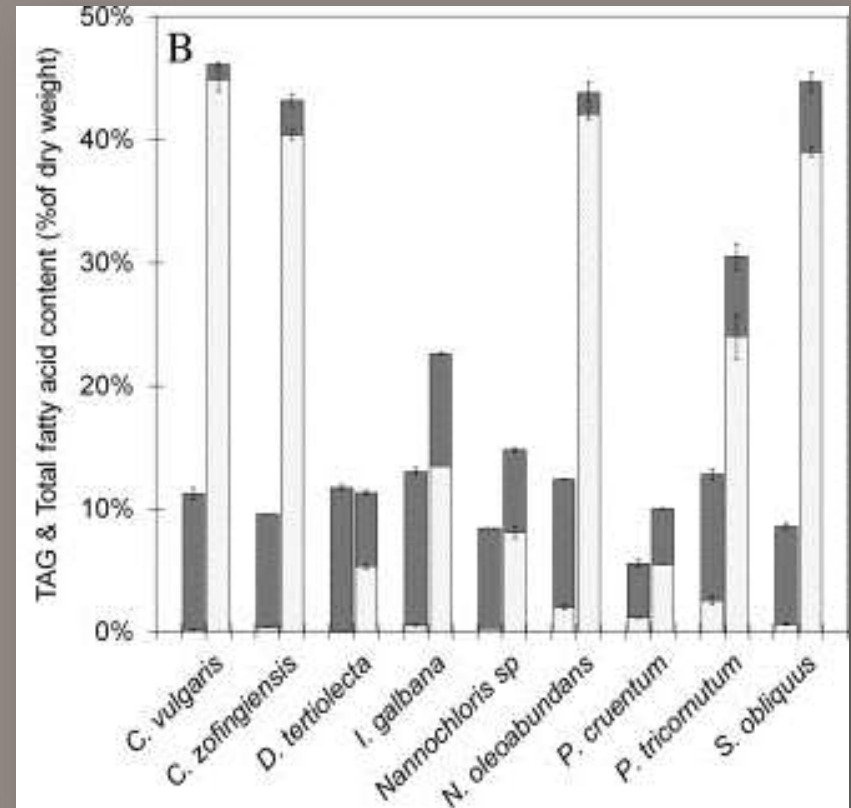
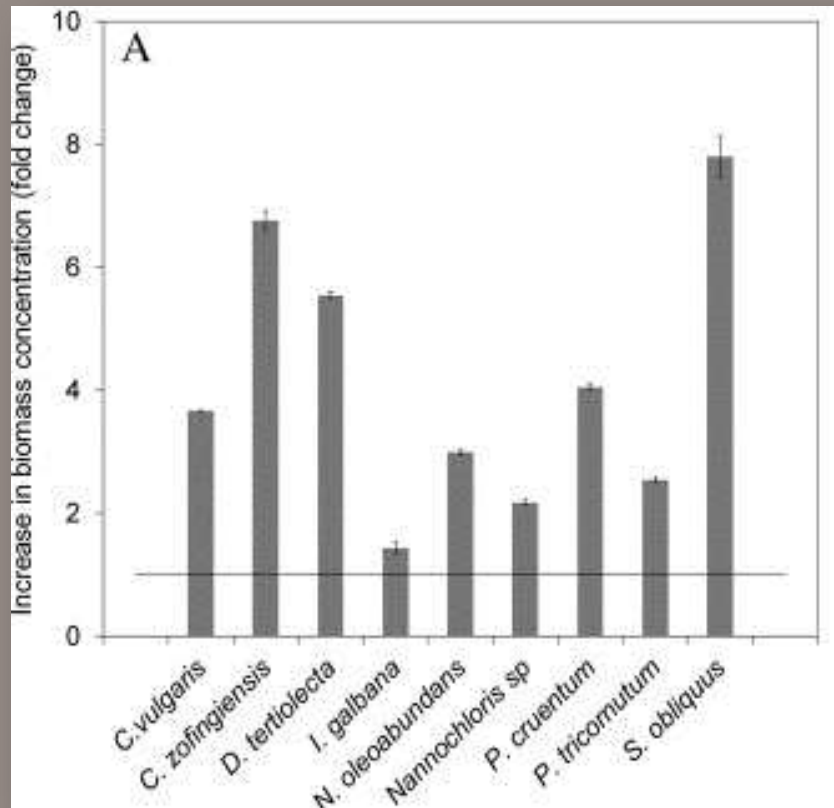


Y. Li et al (2010)



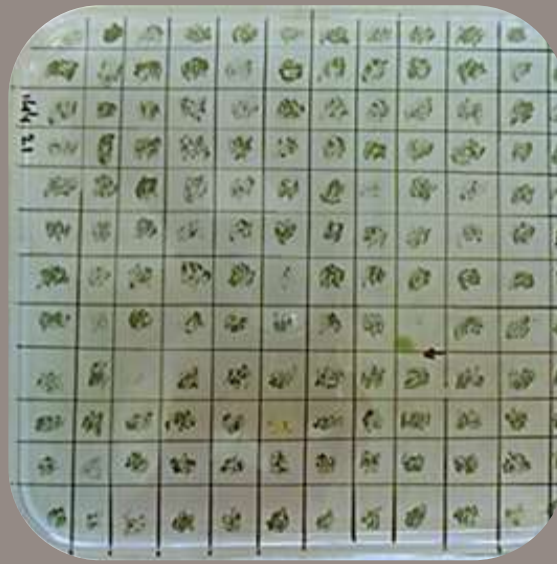
Species	Volumetric biomass productivity (mg/l/day)	Volumetric fatty acid productivity (mg/l/day)	Average volumetric TAG productivity (mg/l/day)
<i>C. vulgaris</i>	489	173	134
<i>C. zofingiensis</i>	674	301	242
<i>N. oleoabundans</i>	799	265	216
<i>P. tricornutum</i>	413	109	45
<i>S. obliquus</i>	822	498	323

Adapted from Breuer et al. 2012

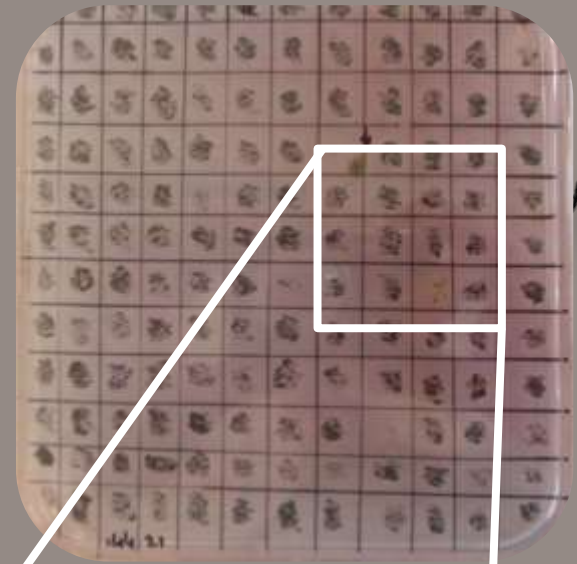




TAP



TAP



TAP -N



Wt mt CC-4325



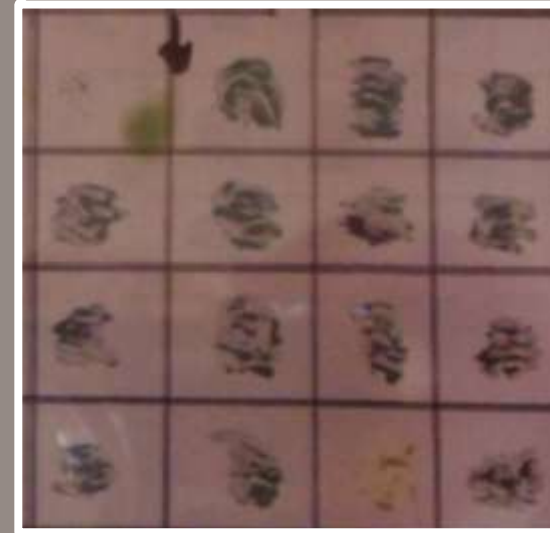
mt 4 mt 3

mt 1

mt 2

3291 mutants

6 interesting

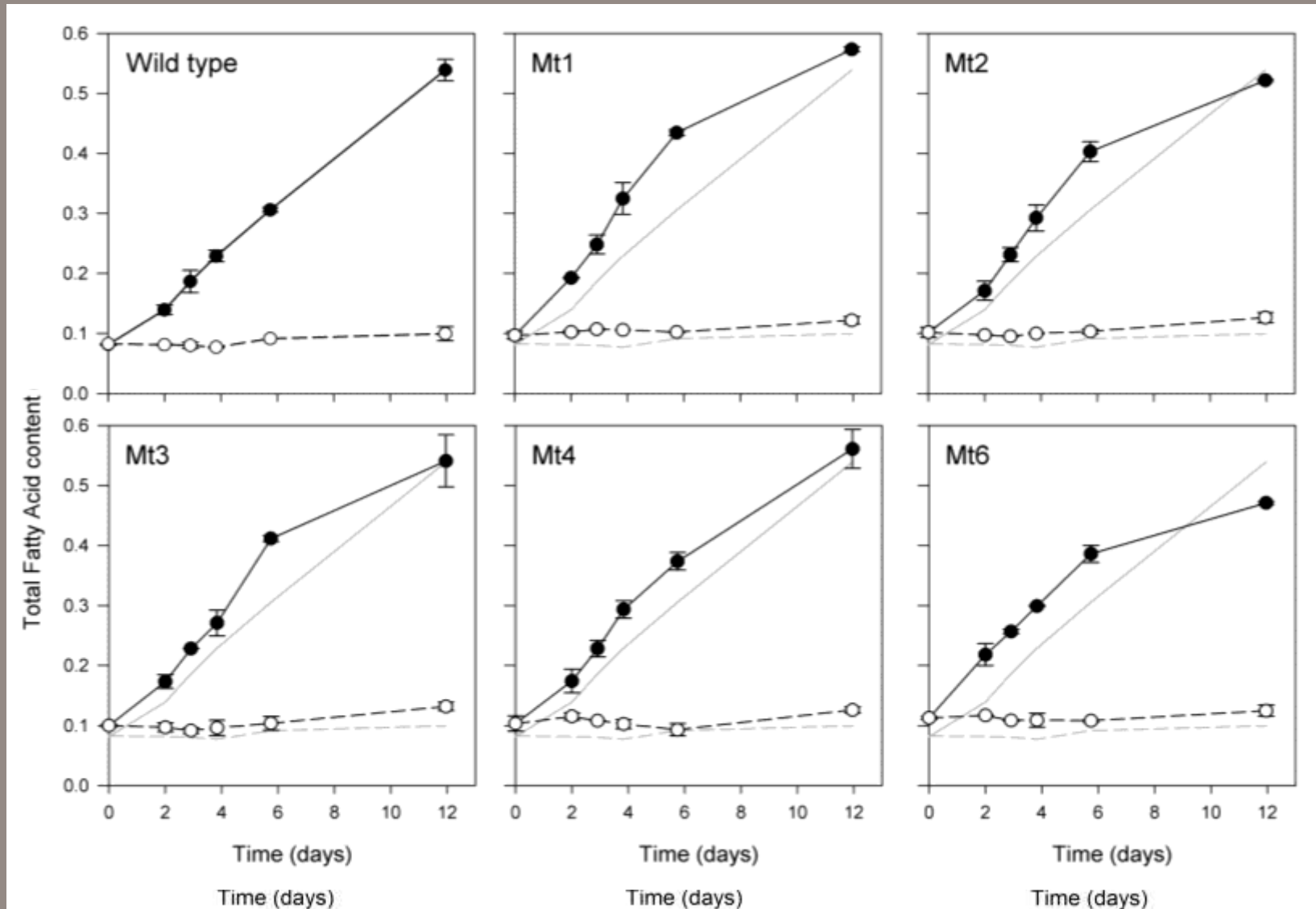


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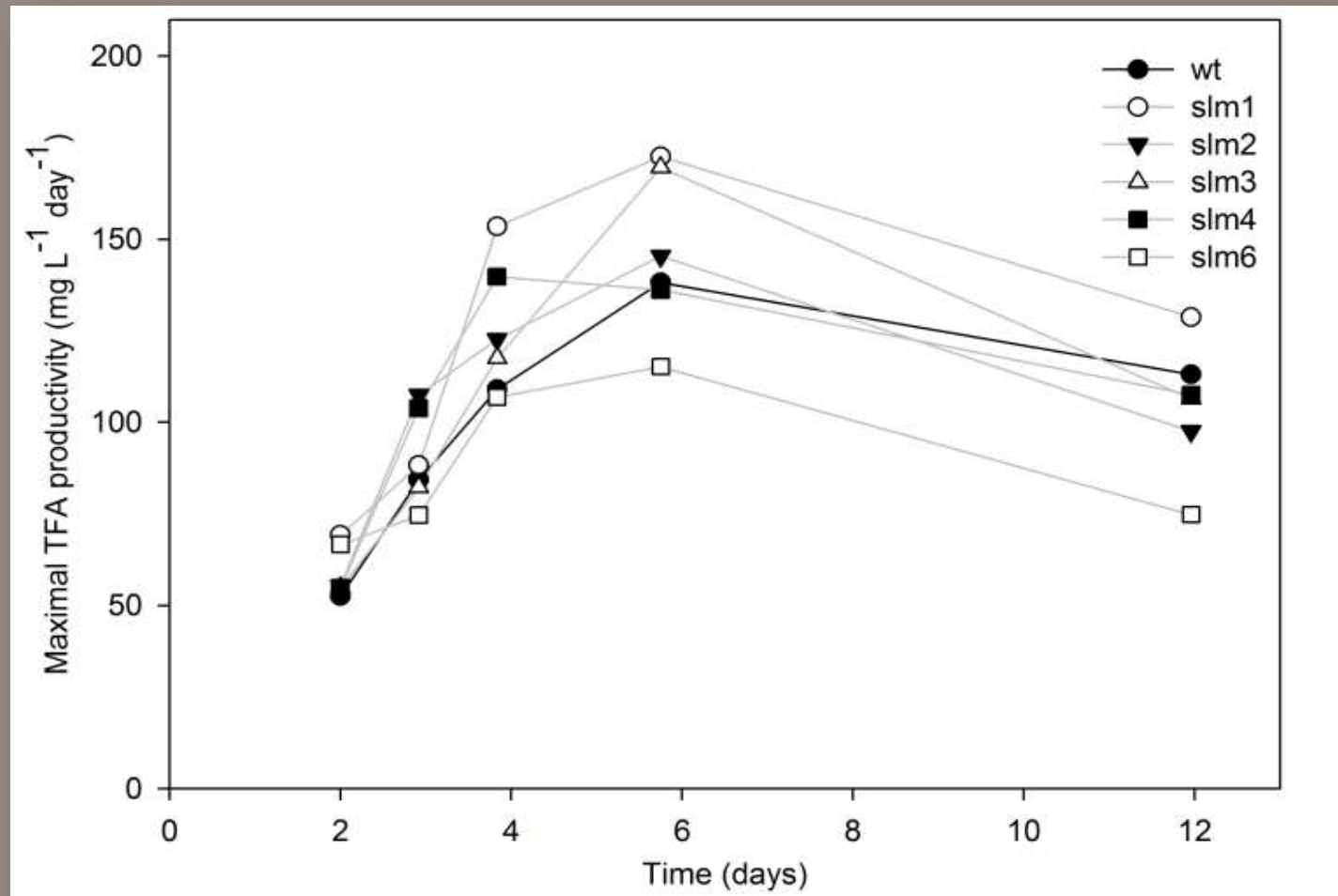
L de Jaeger et al (2014)



Metabolite production



Productivity

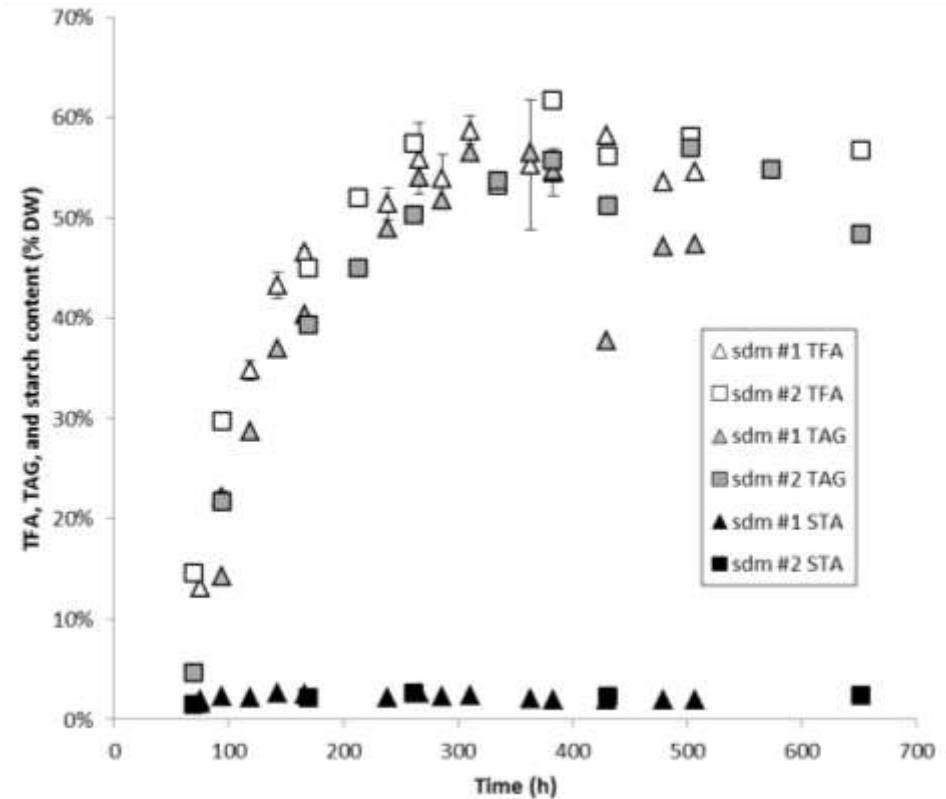
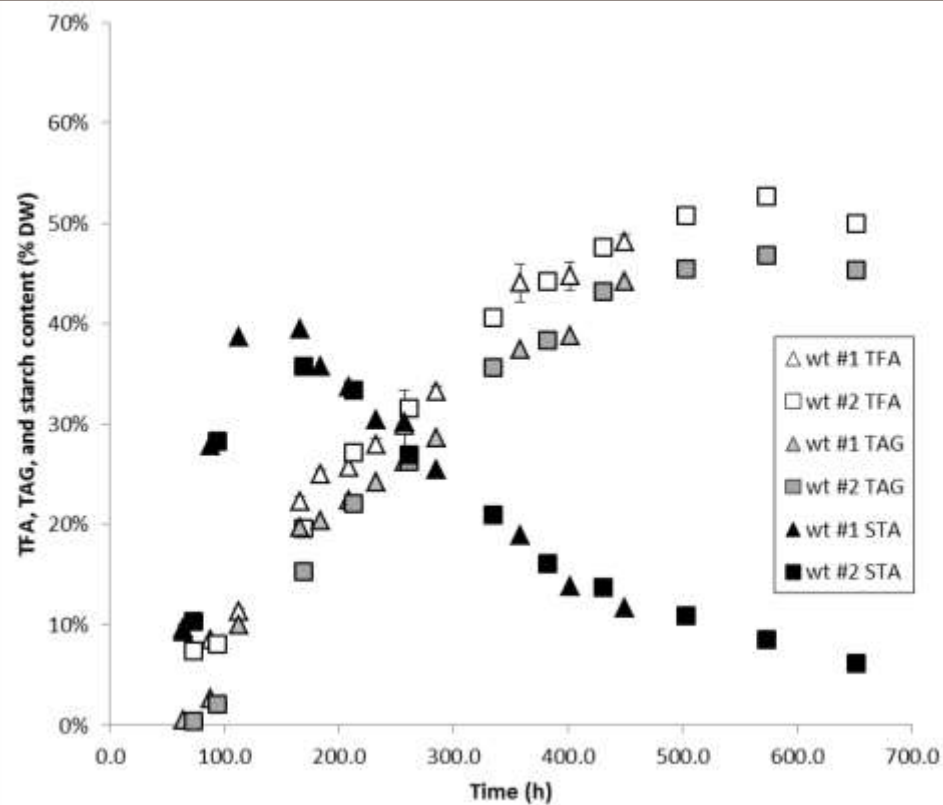


Controlled fermentation experiments

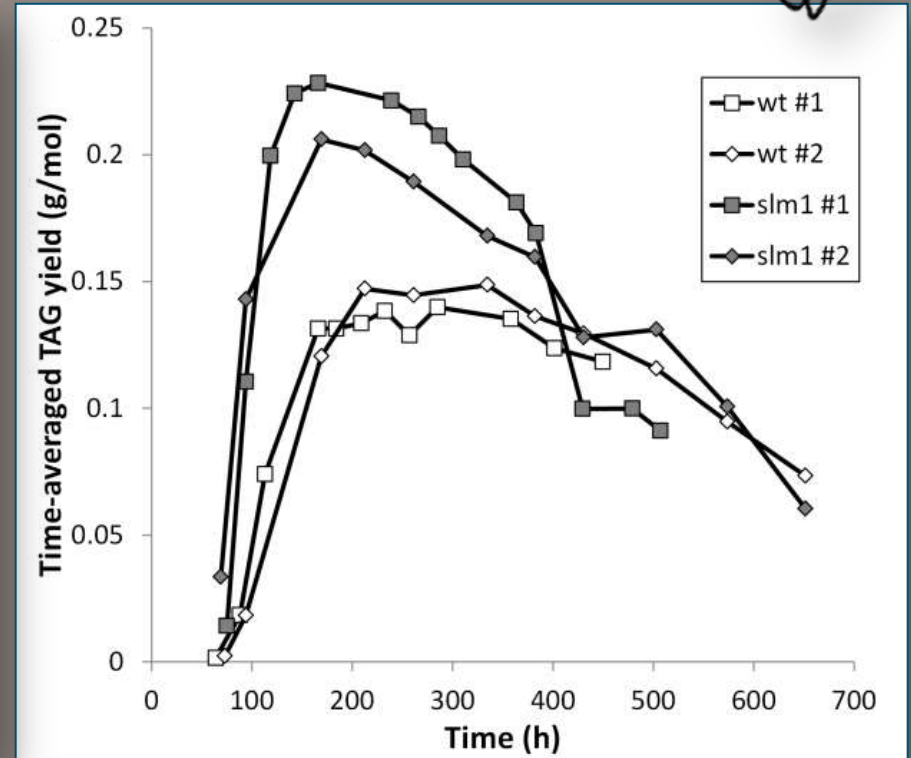
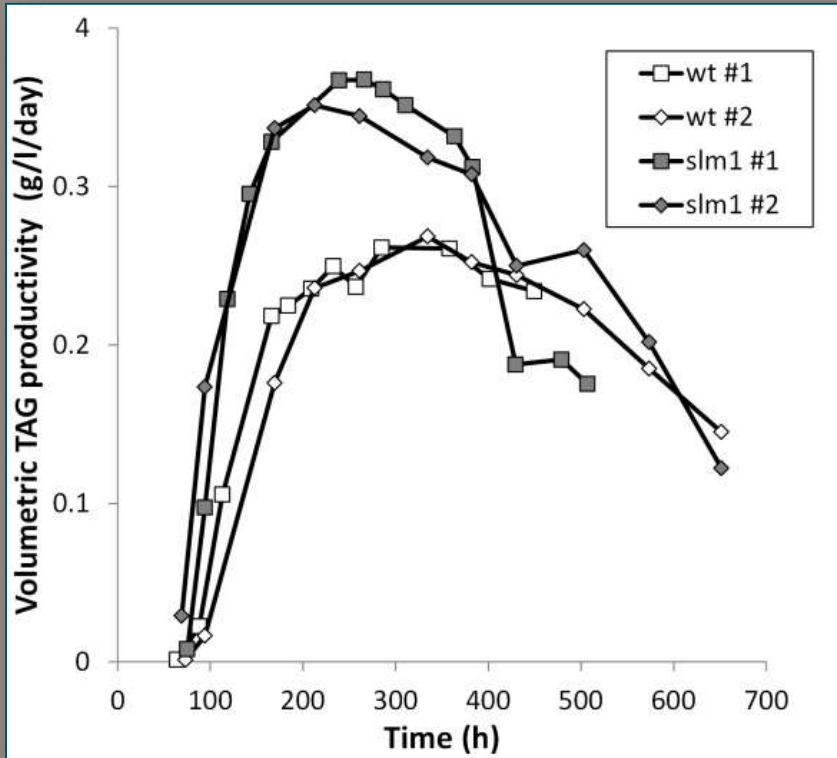


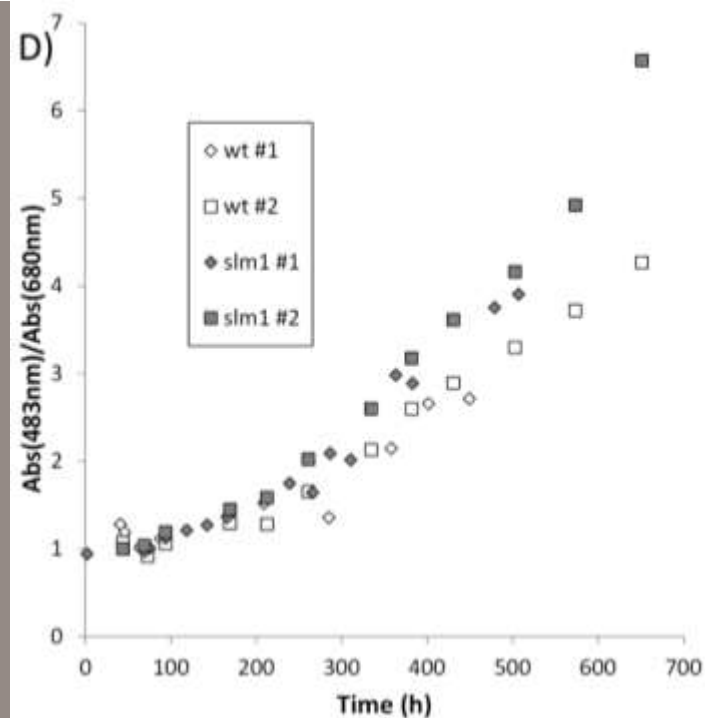
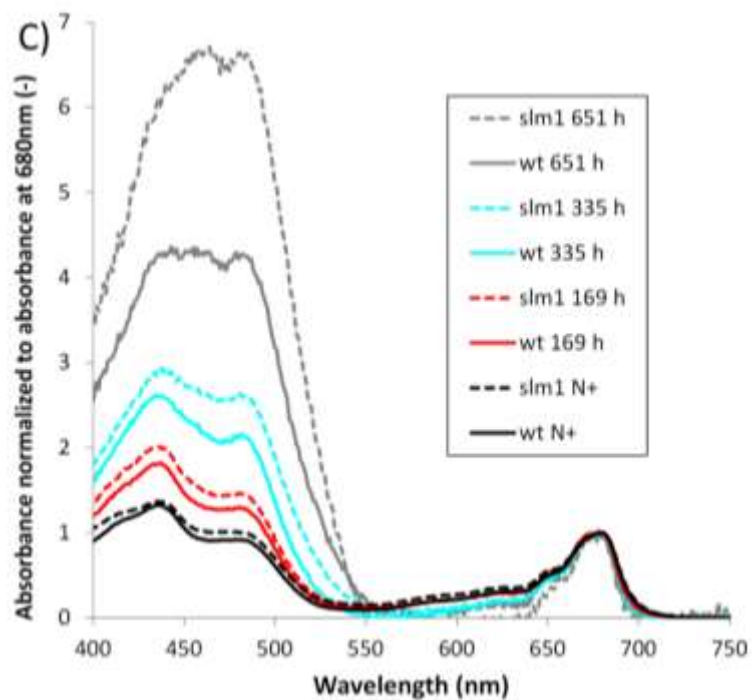
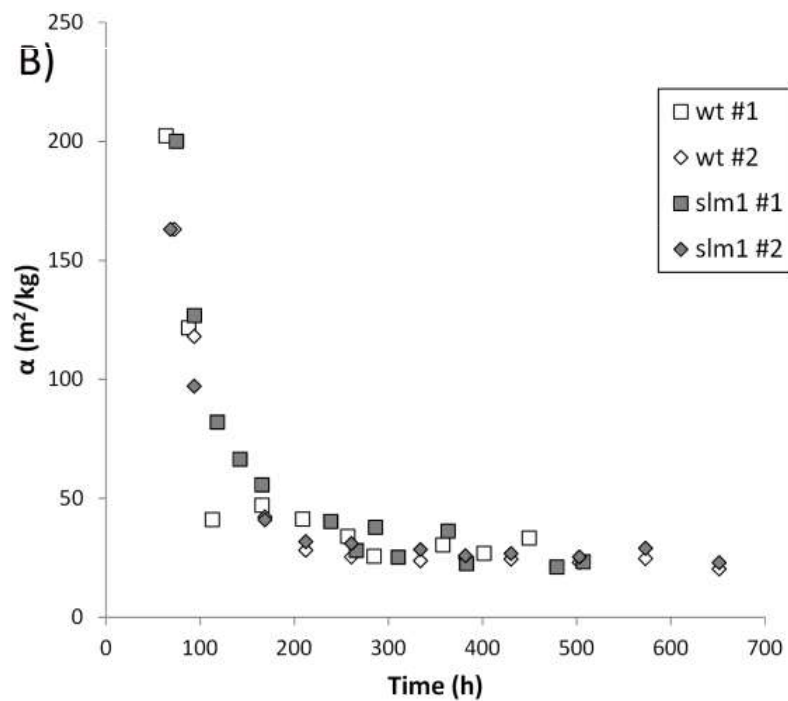
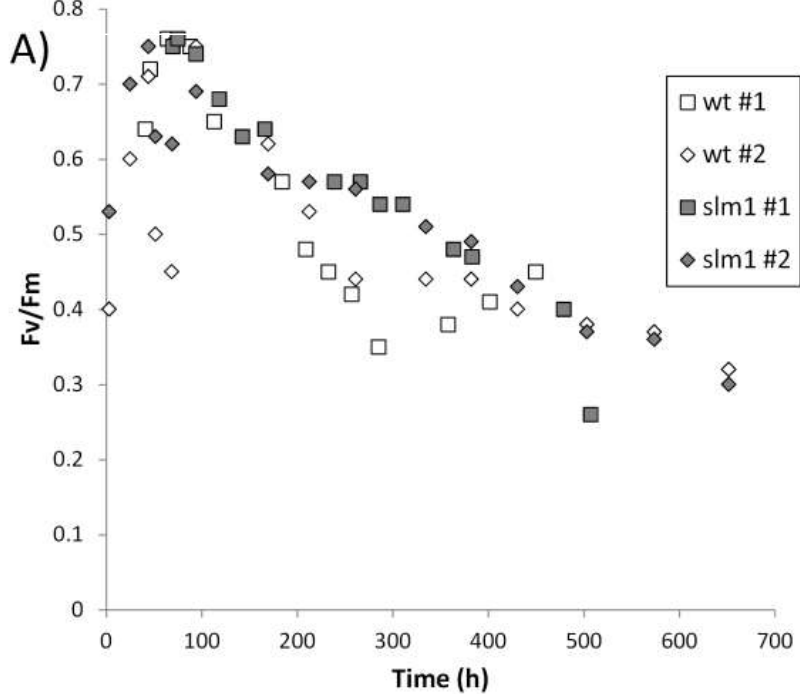
Wild type

Slm1



TAG yield on light and productivity

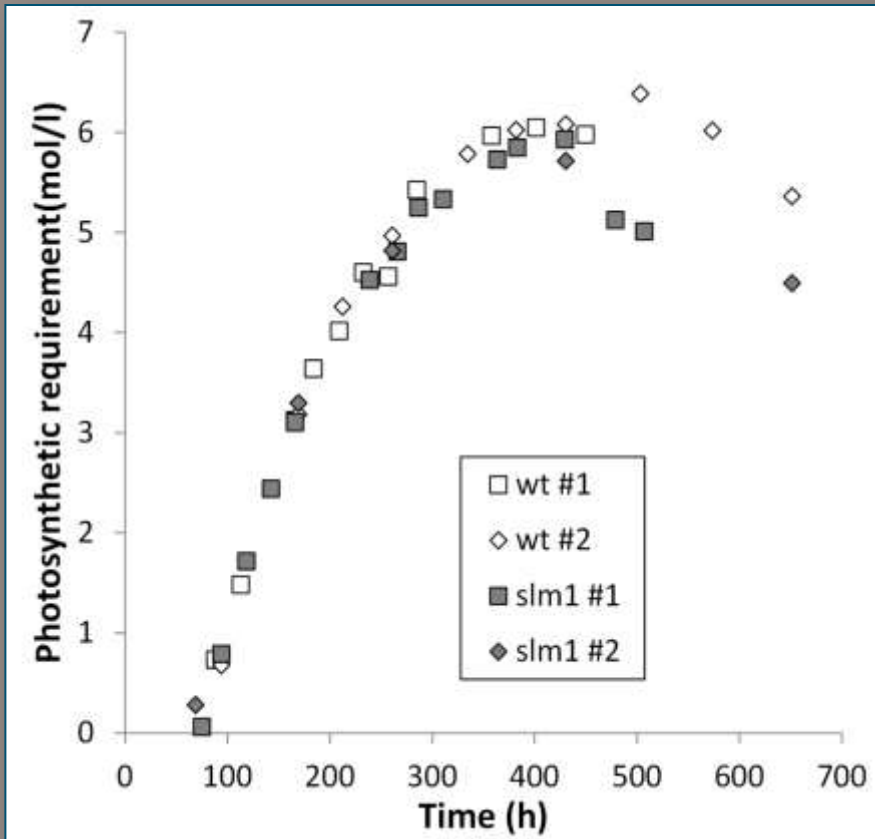




Photosynthetic requirements



$$PR(t) = \frac{C_{TAG}(t)}{Y_{TAG, light}} + \frac{C_{starch}(t)}{Y_{starch, light}} + \frac{C_{carbohydrate}(t)}{Y_{carbohydrate, light}}$$



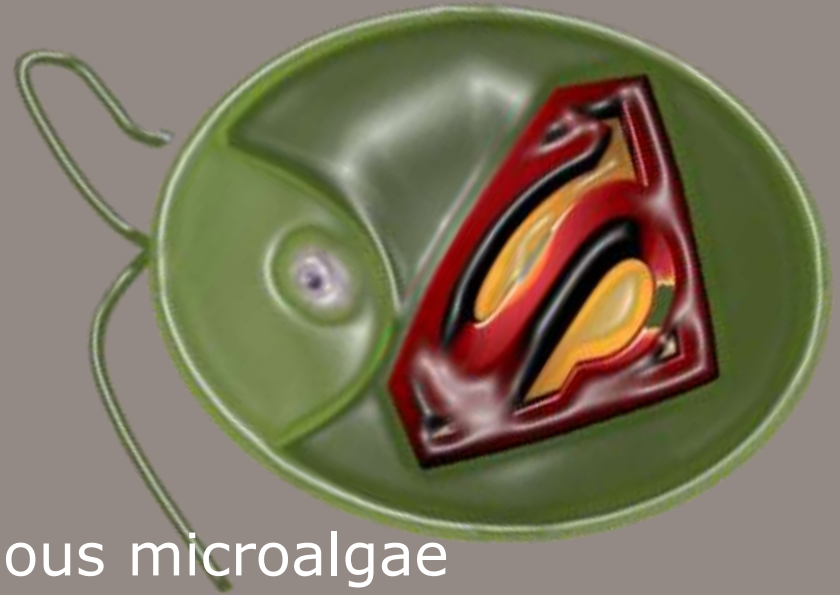
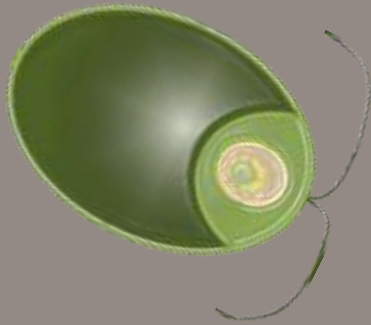
Photosynthetic yields:

$Y_{TAG, light}$: 1.02 g/mol photon

$Y_{starch, light}$: 3.24 g/mol photon

$Y_{carb, light}$: 3.24 g/mol photon

Microalgal Productivity



- Starchless mutants in oleaginous microalgae
- Small effect on biomass productivity (energy requirement TAG vs starch)
- Improved carbon partitioning towards TAG:
 - TAG content $45 \pm 1\%$ vs. $57 \pm 0.2\%$ (%DW)
 - Maximum yield of TAG on light 0.144 ± 0.004 to 0.217 ± 0.011 g TAG/mol photon
 - 51% improvement in max. areal TAG productivity

Discussion

Many thanks to:

Unilever

Food Nutrition Delta

The Algae Foundation

Guido Breuer

Dirk Martens

Packo Lamers

Jan Springer

Ruben Verbeek

Rene Draaisma

Gerrit Eggink

Rene Wijffels

