



HAL
open science

Screening for astaxanthin production by cultures of microalgae within integrated photobioreactors façade

Astrid de Luca, Catherine Dupré, Jeremy Pruvost, François Le Borgne, Olivier Lépine, Jack Legrand, Dominique M Grizeau

► To cite this version:

Astrid de Luca, Catherine Dupré, Jeremy Pruvost, François Le Borgne, Olivier Lépine, et al.. Screening for astaxanthin production by cultures of microalgae within integrated photobioreactors façade. 3rd European Congress of Applied Biotechnology (ECCE10-ECAB3-EPIC5), Sep 2015, Nice, France. hal-02567648

HAL Id: hal-02567648

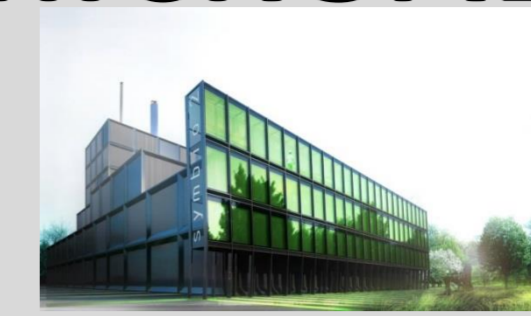
<https://hal.science/hal-02567648>

Submitted on 22 Aug 2023

HAL is a multi-disciplinary open access archive for the deposit and dissemination of scientific research documents, whether they are published or not. The documents may come from teaching and research institutions in France or abroad, or from public or private research centers.

L'archive ouverte pluridisciplinaire **HAL**, est destinée au dépôt et à la diffusion de documents scientifiques de niveau recherche, publiés ou non, émanant des établissements d'enseignement et de recherche français ou étrangers, des laboratoires publics ou privés.

SCREENING FOR ASTAXANTHIN PRODUCTION BY CULTURES OF MICROALGAE WITHIN INTEGRATED PHOTOBIOREACTORS FAÇADE

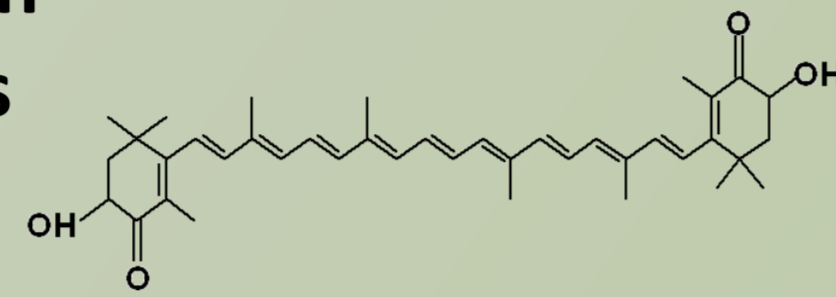


Astrid De Luca^{1,2}, Catherine Dupré¹, Jeremy Pruvost^{1,2}, François Leborgne², Olivier Lépine², Jack Legrand^{1,2}, Dominique Grizeau¹
¹ GEPEA Laboratory, University Nantes, UMR-CNRS 6144, 44602 Saint-Nazaire Cedex, France, ² Algosource Technologies, Saint-Nazaire Cedex, France

Context

New closed photobioreactors designs for microalgae cultivation

- sustainably producing high yields of value-added products
astaxanthin 2000 \$ / kg (Lorenz & Cysewski, 2000)
- potent antioxidant
- prevention of age related macular degeneration (Yamashita, 2013)



- *Haematococcus pluvialis* astaxanthin up to 3 % DW (Lorenz & Cysewski, 2000)

Symbio2 project :

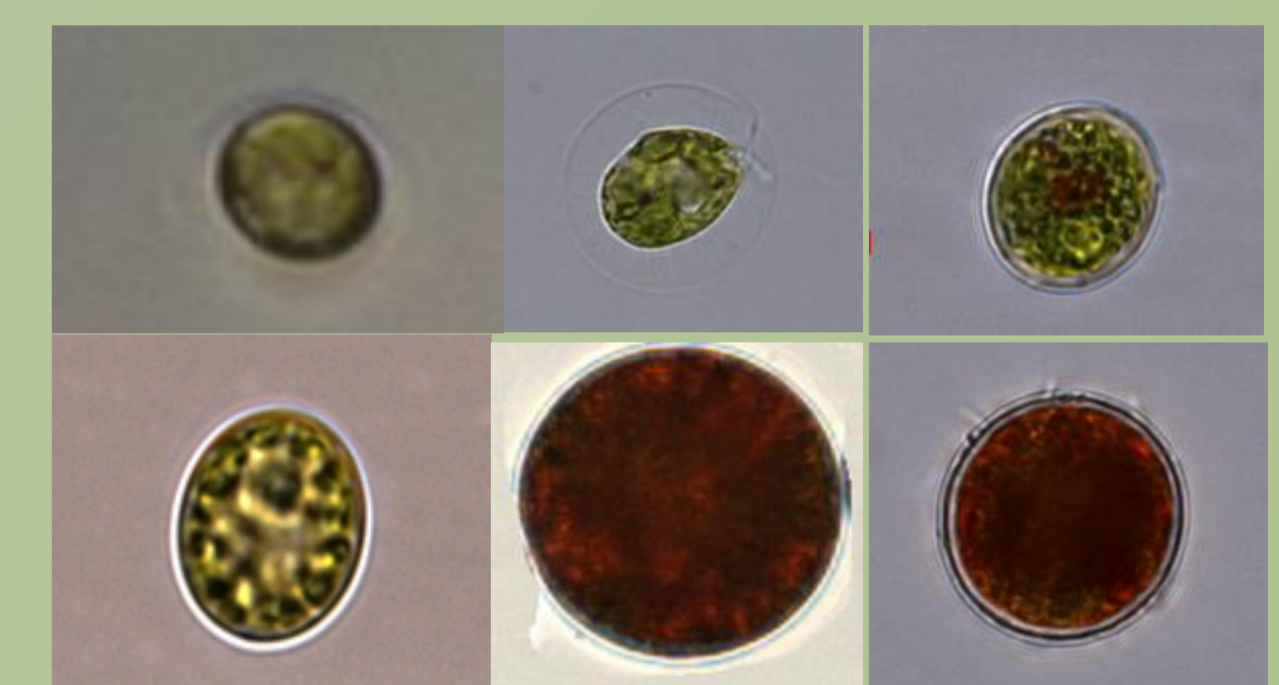
- Production of microalgae in biofacades photobioreactors (Pruvost *et al.*, 2015)
- Continuous-flow culture system
- No biofouling or biomass sedimentation ; control of encystement
- High astaxanthin productivities

Objectives

Use of microplates to :

- screen microalgae species for astaxanthin accumulation.
- compare the efficiency of different factors for triggering astaxanthin synthesis

Strain	Size (µm)	Cultivation in photobioreactors
M1	13-27	X
M2	5-8	X
M3	15-30	✓
M4	18-23	X



Whole cells spectrophotometric characterization

in situ measurements

Miniaturization of end-point assays

ex situ measurements

Limits of quantitation (LOQ) and saturation (LOS)

Signals (inter)calibration

Methodology

Cell incubation 96 and 24 wells microplates

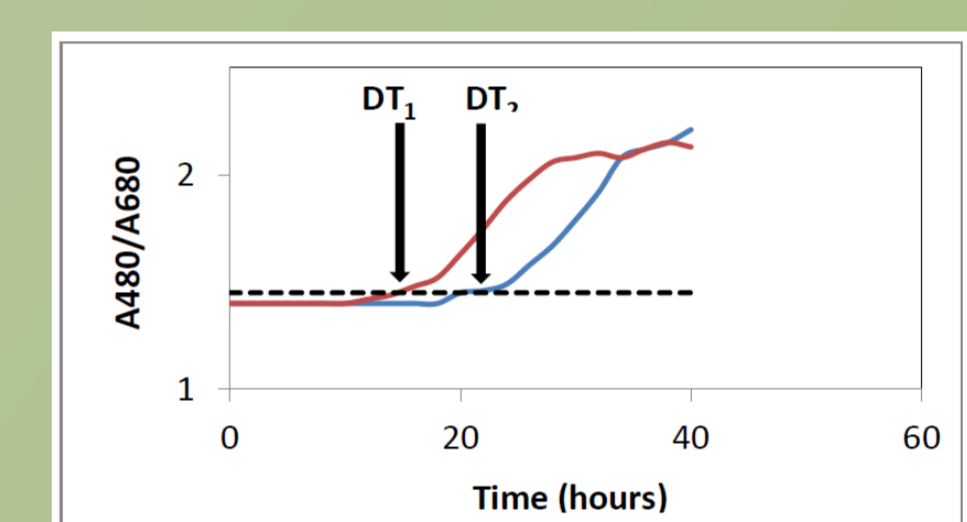
Control of environmental parameters ; PFD, T, rpm

Inoculum pre-treatments for batch incubations

Well-controlled initial nutrients status

Carotenoid induction

Identification of potent factors



Data treatment → Detection time (DT)
(Grizeau *et al.*)

Microalgae incubations

- Astaxanthin C₄₀H₅₂O₄
- C-sufficient medium with NaHCO₃

➢ Control of culture incubation :

Parameter	Value
Temperature (°C)	20
PFD (µmol photons m ⁻² s ⁻¹)	100
Light path (mm)	96 wells : 5 24 wells : 4,5

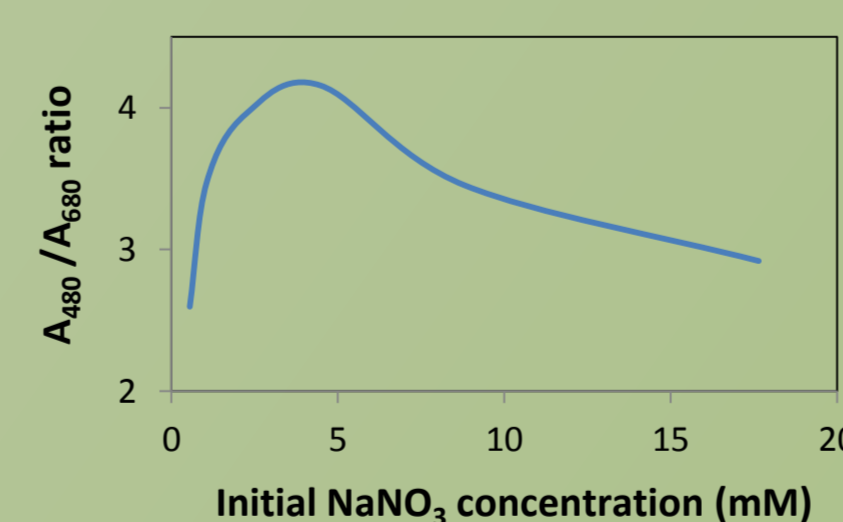
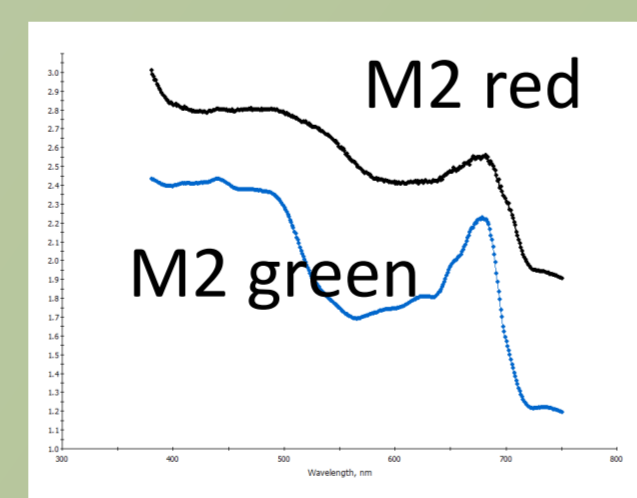
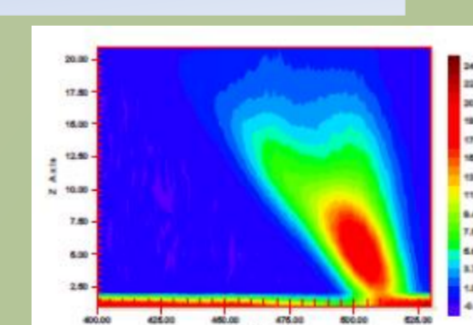
➢ incubation and reading



Multimode microplates reader

In situ measurements

- A₇₅₀ to estimate residual growth
- Fluorescence Ex₄₄₀/Em₆₇₀ = f ([chlorophylle])
- A₄₈₀/A₆₈₀ ratio = f (time)
- Threshold of carotenogenesis = f (1/DT)



[NaNO₃]_{opt} for carotenogenesis in M2 cells

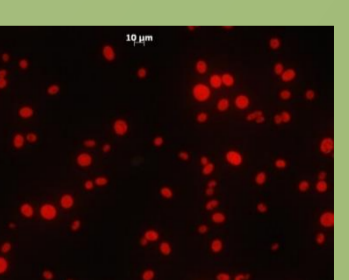
Ex situ measurements

Exemple 24 wells microplate :

- 200 µL extracted with DMSO :
spectrophotometry → [Total carotenoids]
HPLC analysis → [Astaxanthin]
→ carotenoid profile



- 2 µL photosynthetic activities :
→ Fv/Fm, NPQ and PI curves
- Microscopy / Image analysis
→ cell numeration
- Epifluorescence
→ cell viability
- Nitrate determination
→ conversion yields



Conclusions - perspectives

- Efficiency of a microplates format utilization for comparative studies of microalgae carotenogenesis
- Combining *in situ* and *ex situ* measurements → data acquisition for screening the efficiency of inducing factors on carotenogenesis
- Futur prospects ; improvements by using an automated workstation allowing semi-continuous cultures within microplates

