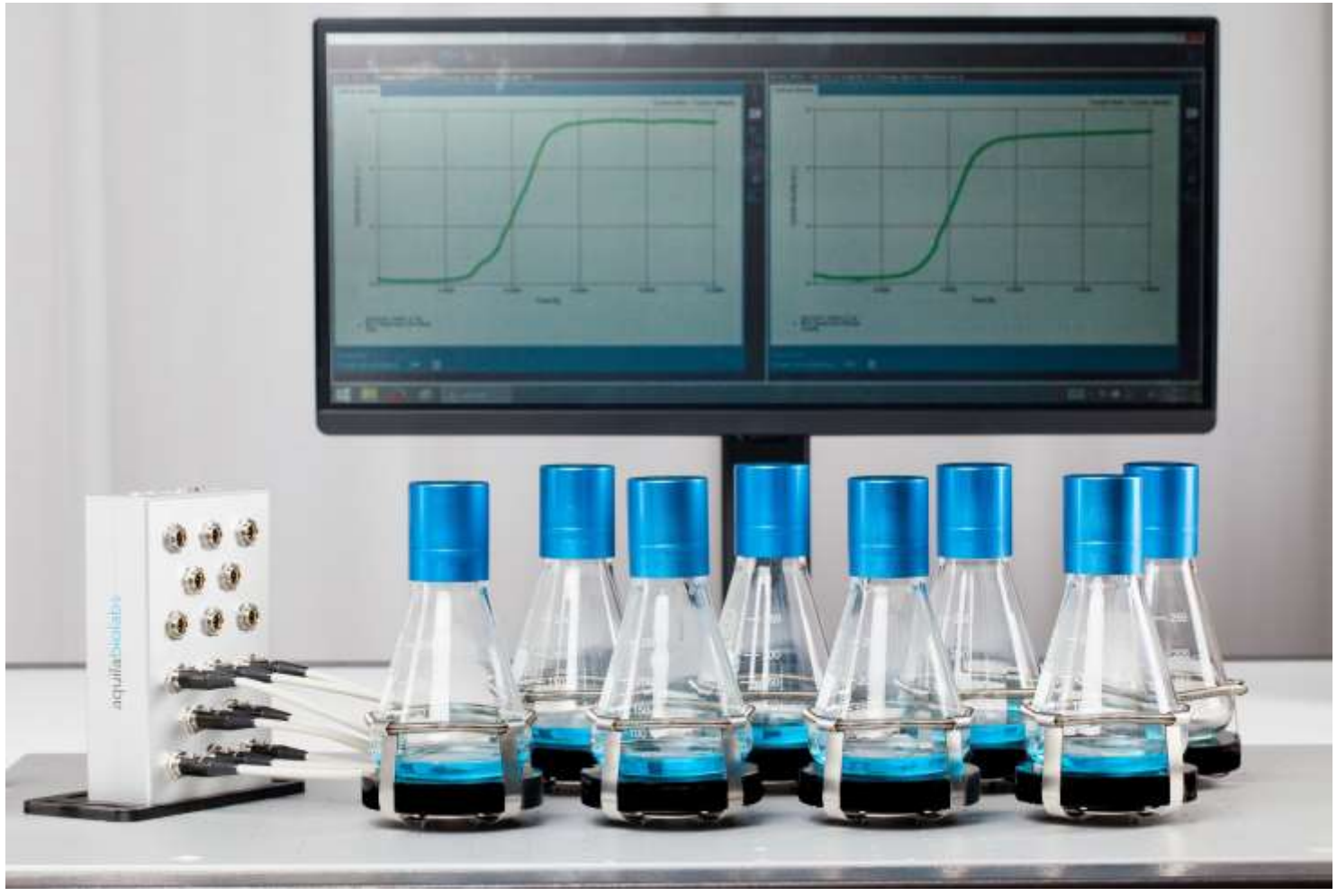
Cell Growth Quantifier (CGQ)

Online Biomass Monitoring in Shake Flasks

The Cell Growth Quantifier (CGQ) is a bioprocess analytical technology allowing for non-invasive online biomass monitoring in shake flask cultures.

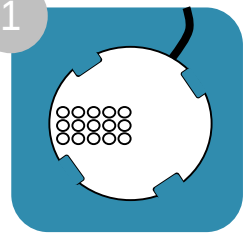
The CGQ Technology



A CGQ system consists of four components: the sensor plates, the covers, the base station and the software CGQuant.

Components of the CGQ System

1



Sensor Plate

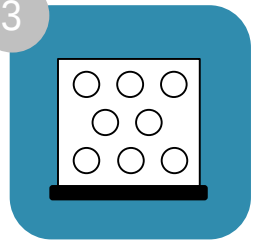
The sensor plates are positioned under the shake flask and measure the biomass non-invasively.

2

Cover

Each shake flask is darkened with a cover to ensure measurements of highest precision and sensitivity.

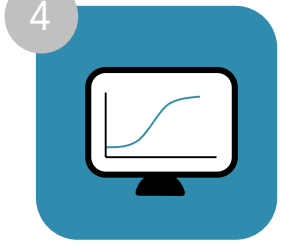
3



Base Station

The base station bundles the data from all monitored flasks and sends it to the software CGQuant.

4



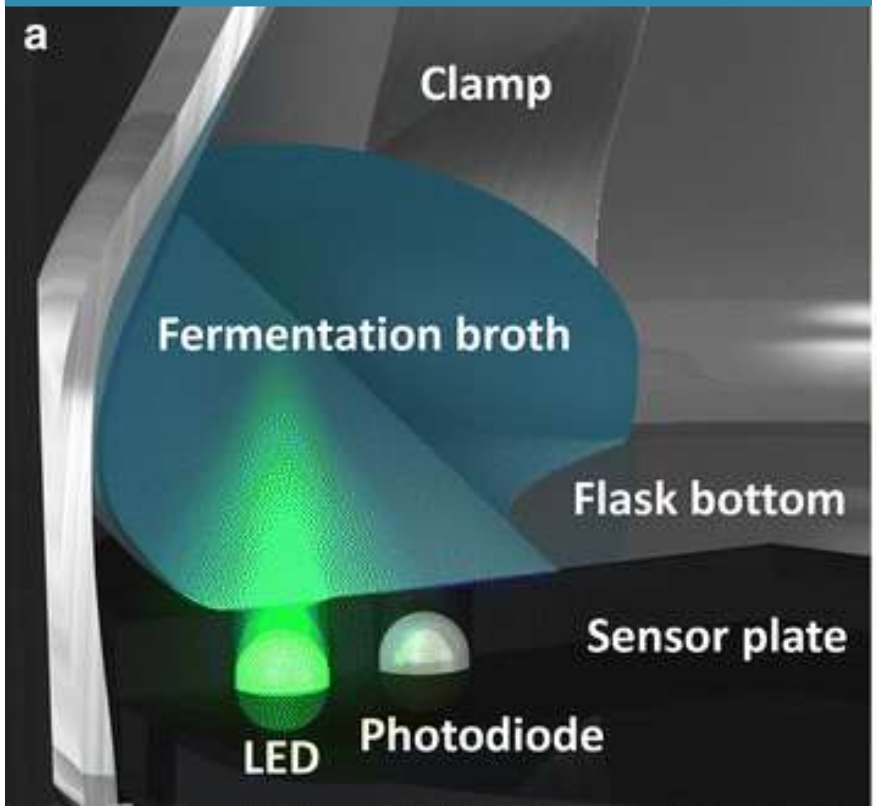
CGQuant

The software CGQuant analyzes and visualizes the biomass signal from all monitored shake flasks.

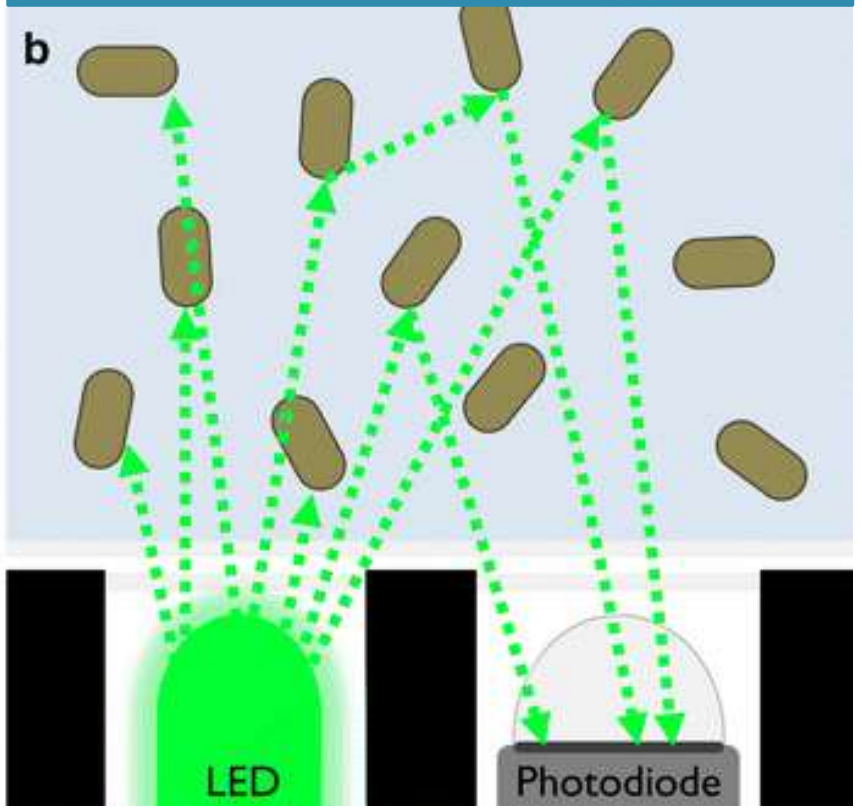
The CGQ implements a dynamic approach of backscattered light measurement, allowing for accurate biomass monitoring in shaken cultures.

The Principle of Measurement

CGQ Sensing Architecture



Biomass Monitoring by Backscattered Light Detection



aquila biolabs has developed a sensor capable of monitoring biomass non-invasively through the glass wall of a shake flask.

100 ml Sensor Plate

aquila biolabs' universal adapter system allows the customer to use the same sensor for various shake flask sizes.

The Model „One sensor for all shake flask sizes“

100 ml Sensor Plate

250 ml Universal Adapter

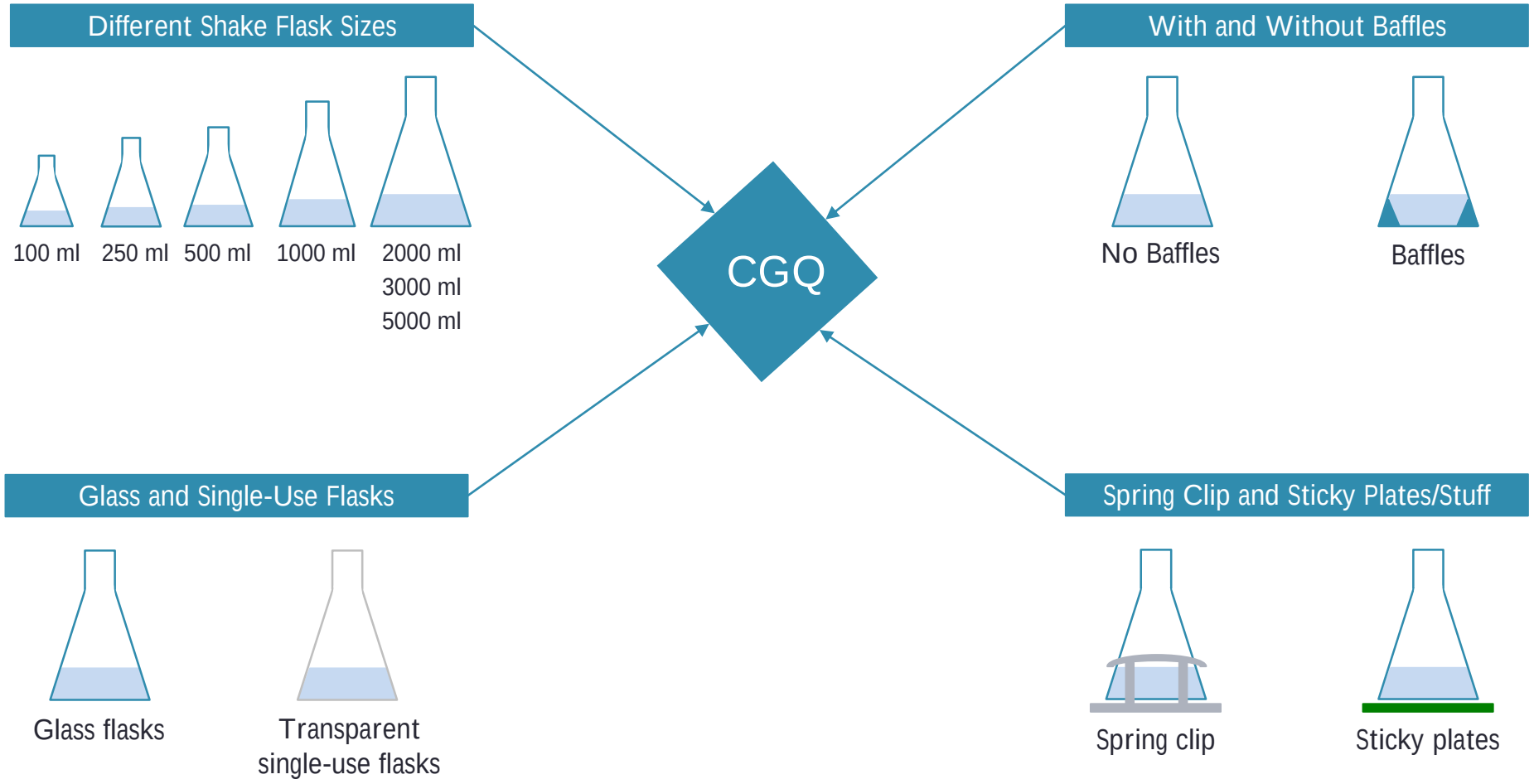
Sensor Plate for 250 ml Flask

Advantages

- Maximum flexibility: the same sensor plate can be used for different shake flask sizes.
- If an existing customer decides to monitor other flask sizes at one point, he now only needs to invest into adapters instead of buying additional sensor plates.

The CGQ is compatible with all sizes and kinds of shake flasks (and even other vessels) as well as every common type of shaker.

Compatible Laboratory Infrastructure



Various organisms ranging from bacteria and archaea over yeast to microalgae have been successfully monitored with the CGQ technology.

Successfully Monitored Organisms

Bacteria

- *Escherichia coli*
- *Corynebacterium glutamicum*
- *Bacillus subtilis*
- *Pseudomonas putida*
- *Streptomyces venezuelae*
- *Gluconobacter oxydans*
- *Lactobacillus plantarum*
- *Vibrio natriegens*
- *Vibrio cholerae*
- *Staphylococcus aureus*
- *Klebsiella pneumoniae*
- *Actinobacillus pleuropneumoniae*
- *Chromobacterium violaceum*
- *Acetobacterium woodii*
- *Clostridium acetobutylicum*
- *Clostridium ljungdahlii*
- *Clostridium difficile*
- *Prevotella copri*

Yeast

- *Saccharomyces cerevisiae*
- *Schizosaccharomyces pombe*
- *Pichia pastoris*
- *Yarrowia lipolytica*
- *Kluyveromyces lactis*
- *Hansenula polymorpha*

Archaea

- *Sulfolobus acidocaldarius*
- *Haloferax volcanii*

Others

- *Aspergillus niger*
- *Ustilago maydis*
- *Chlorella vulgaris* (Microalgae)
- *Nicotiana tabacum* BY-2 (Plant Cells)

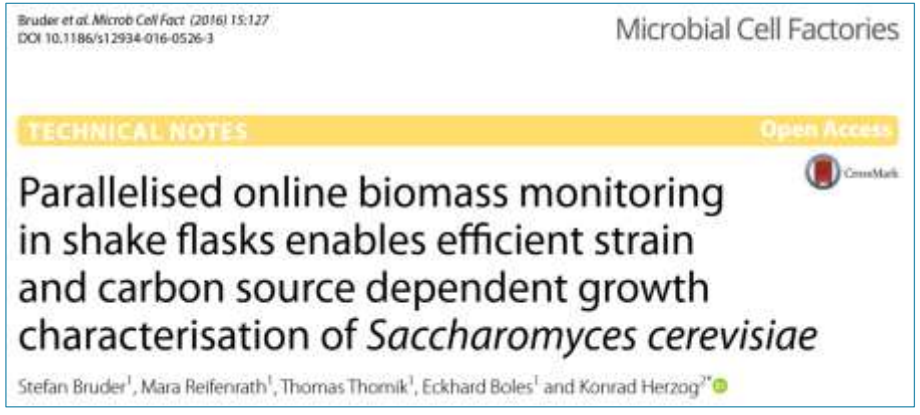
The CGQ technology has been used for a broad range of applications in shake flask fermentations.

List of Applications

- Growth characterisation
- Bioprocess optimisation
- Screening of
  - Strains/Mutants
  - Media
  - Bioprocess conditions (shaking speed, filling volume, temperature, pH…)
- Growth phase-based induction of protein expression
- Phage assays
- Non-invasive monitoring of anaerobic bacteria
- Non-invasive monitoring of thermophilic organisms
- Toxicity tests
- Reproducible production of competent cells
- Up-scaling
- Quality control

The CGQ technology has already been used for several publications in renowned journals.

Exemplary Publications

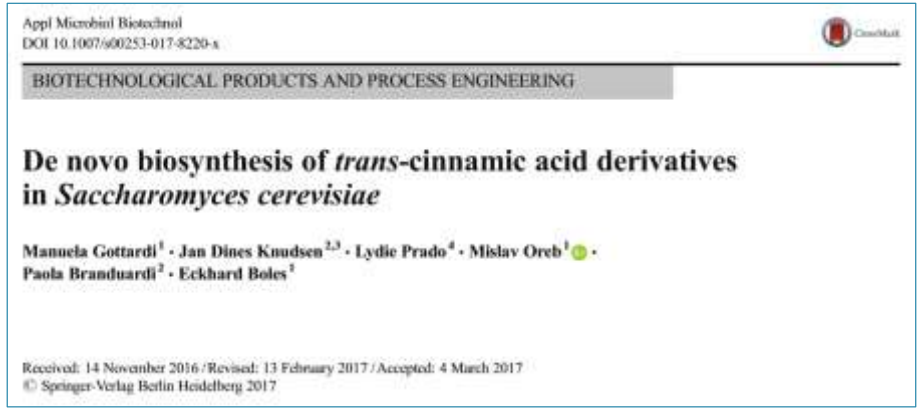

Bruder et al. Microb Cell Fact (2016) 15:127
DOI 10.1186/s12934-016-0526-3

Microbial Cell Factories

TECHNICAL NOTES Open Access

Parallelised online biomass monitoring in shake flasks enables efficient strain and carbon source dependent growth characterisation of *Saccharomyces cerevisiae*

Stefan Bruder[1], Mara Reifenrath[1], Thomas Thomik[1], Eckhard Boles[1] and Konrad Herzog[2*]

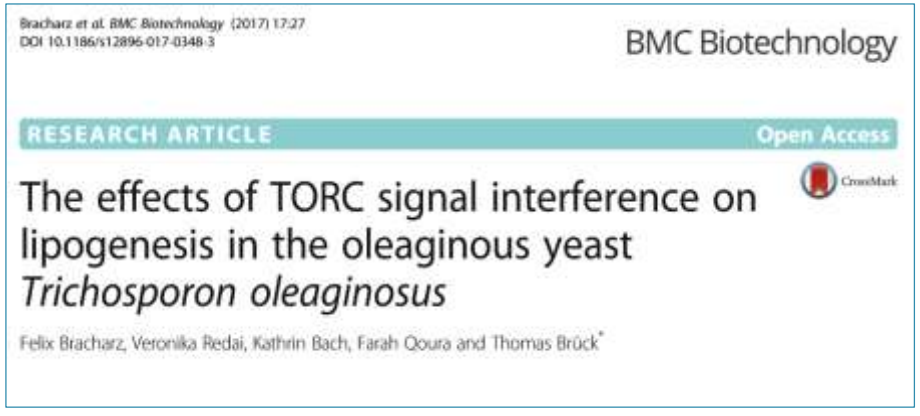

Appl Microbiol Biotechnol
DOI 10.1007/s00253-017-8220-x

BIOTECHNOLOGICAL PRODUCTS AND PROCESS ENGINEERING

De novo biosynthesis of *trans*-cinnamic acid derivatives in *Saccharomyces cerevisiae*

Manuela Gottardi[1] · Jan Dines Knudsen[2,3] · Lydie Prado[4] · Mislav Oreb[1] · Paola Branduardi[2] · Eckhard Boles[3]

Received: 14 November 2016 / Revised: 13 February 2017 / Accepted: 4 March 2017
© Springer-Verlag Berlin Heidelberg 2017


Brachacz et al. BMC Biotechnology (2017) 17:27
DOI 10.1186/s12896-017-0348-3

BMC Biotechnology

RESEARCH ARTICLE Open Access

The effects of TORC signal interference on lipogenesis in the oleaginous yeast *Trichosporon oleaginosus*

Felix Bracharz, Veronika Redai, Kathrin Bach, Farah Qoura and Thomas Brück*


Biochemical Engineering Journal 120 (2017) 103–112

Contents lists available at ScienceDirect

Biochemical Engineering Journal

journal homepage: www.elsevier.com/locate/bej

Regular article

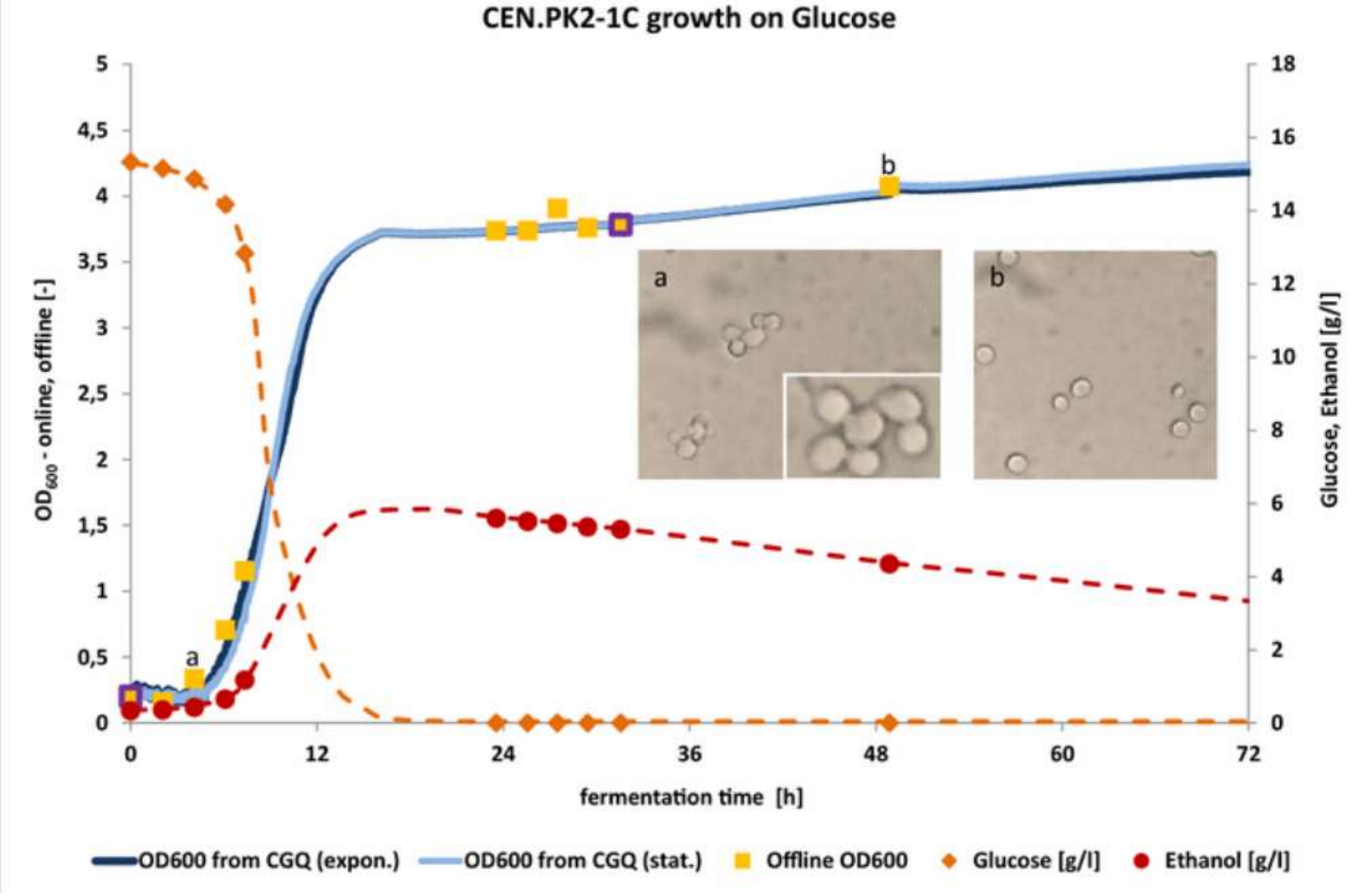
Improvement of the yeast based (*R*)-phenylacetylcarbinol production process via reduction of by-product formation

Stefan Bruder, Eckhard Boles*

Goethe University Frankfurt, Institute of Molecular Biosciences, 60438 Frankfurt am Main, Germany

The online biomass data generated by the CGQ correlates nicely with offline OD data.

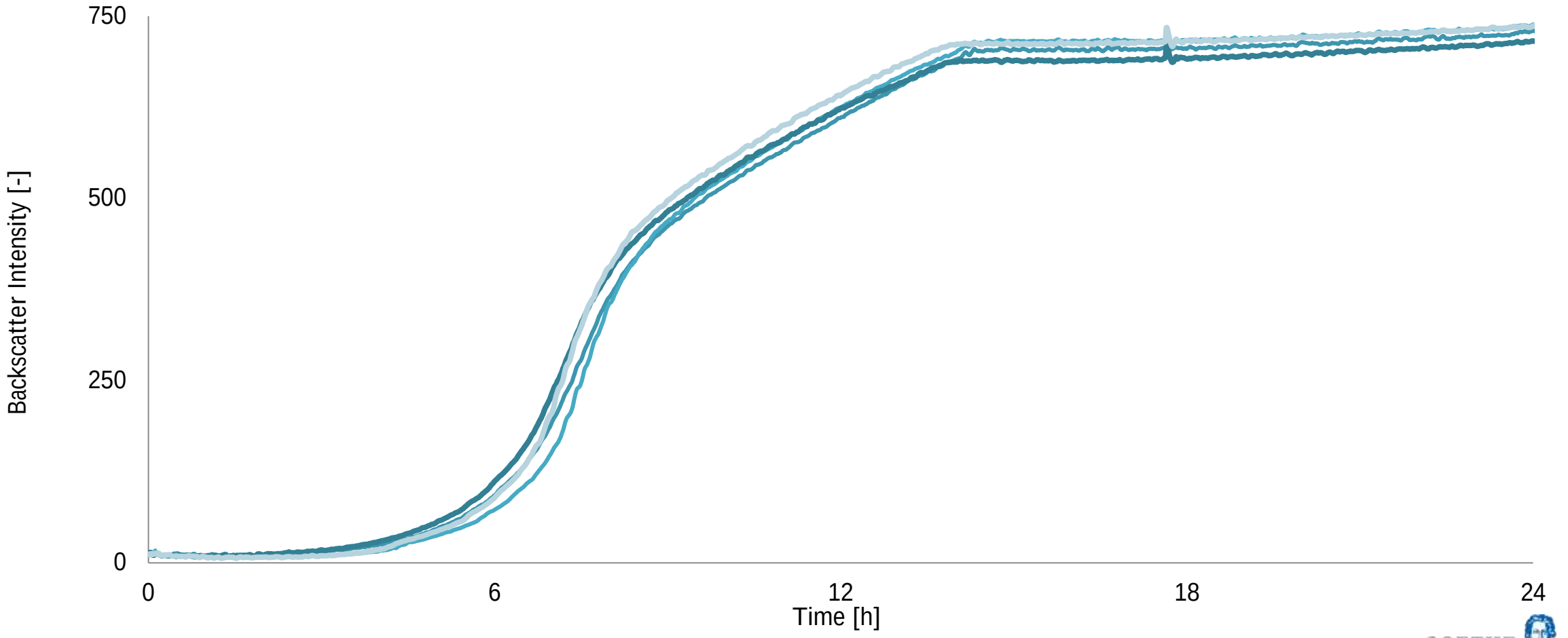
OD & CGQ Measurements (OD Calibrated): *Saccharomyces cerevisiae*



Bruder *et al.* (2016): **Parallelised online biomass monitoring in shake flasks enables efficient strain and carbon source dependent growth characterisation of *Saccharomyces cerevisiae*** (Microbial Cell Factories).

The CGQ allows for highly precise und reproducible biomass measurements in shake flasks.

CGQ Measurements: Four *Saccharomyces cerevisiae* Replicates



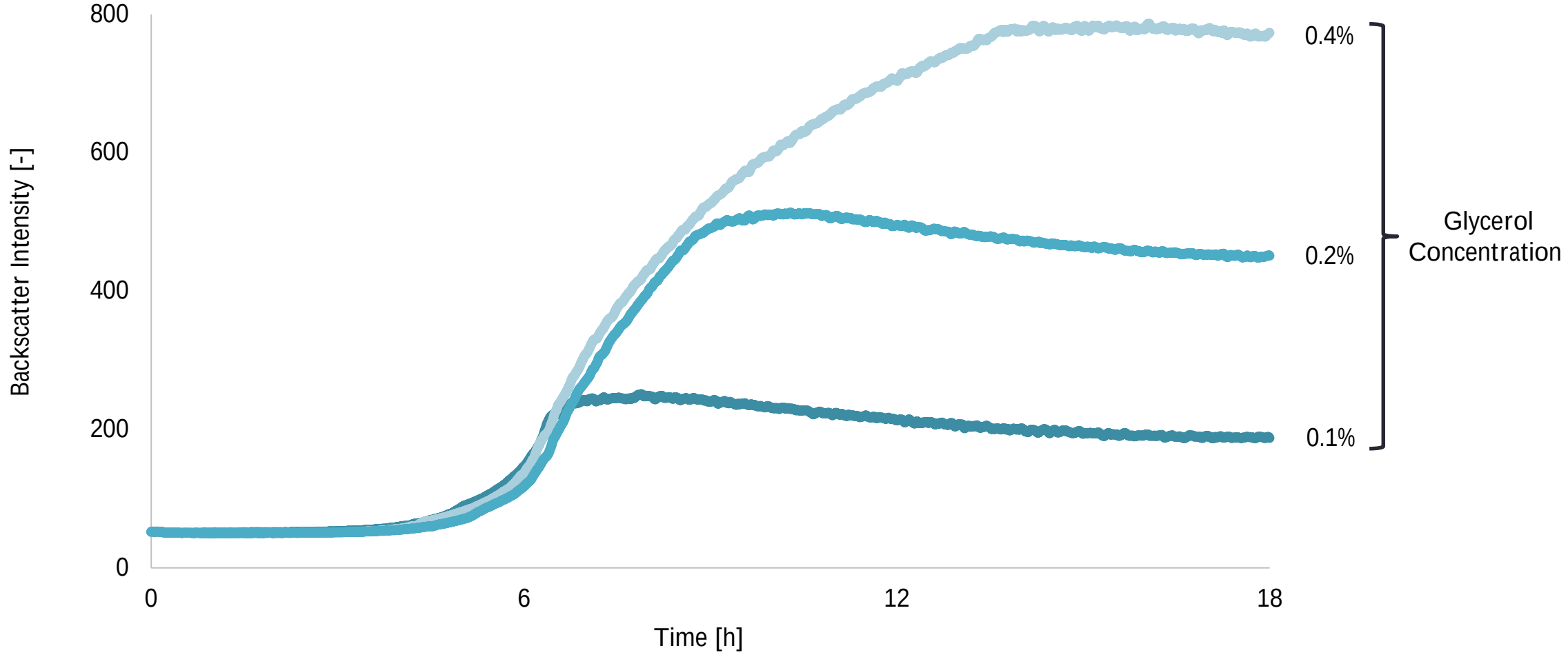
Saccharomyces cerevisiae CEN.PK2.-1C, 50 ml Minimal Medium, 300 ml Shake Flasks, 30 °C, 180 rpm

GOETHE UNIVERSITÄT FRANKFURT AM MAIN

aquilabiolabs

Parallelized online biomass monitoring with the CGQ allows for efficient screenings and growth characterizations.

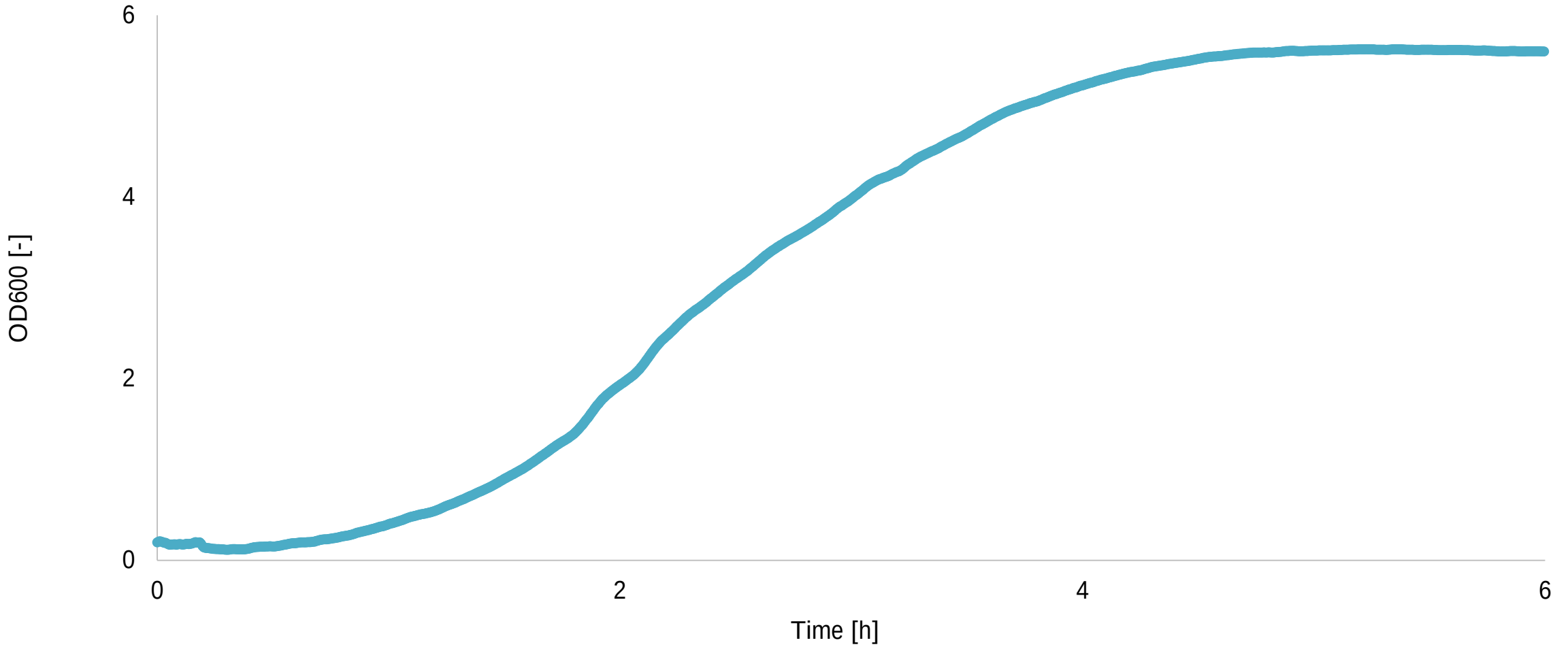
CGQ Measurements: *Escherichia coli* Growing on Different Glycerol Concentrations



Escherichia coli BL21-Gold (DE3) pET28a(+) EGFP Kan^{R}, 25 ml M9 Medium (+ 0.25 % Casamino Acids), 250 ml Shake Flasks, 37 °C, 250 rpm

After a bioprocess-specific OD calibration, the CGQ allows for online OD measurements in real time.

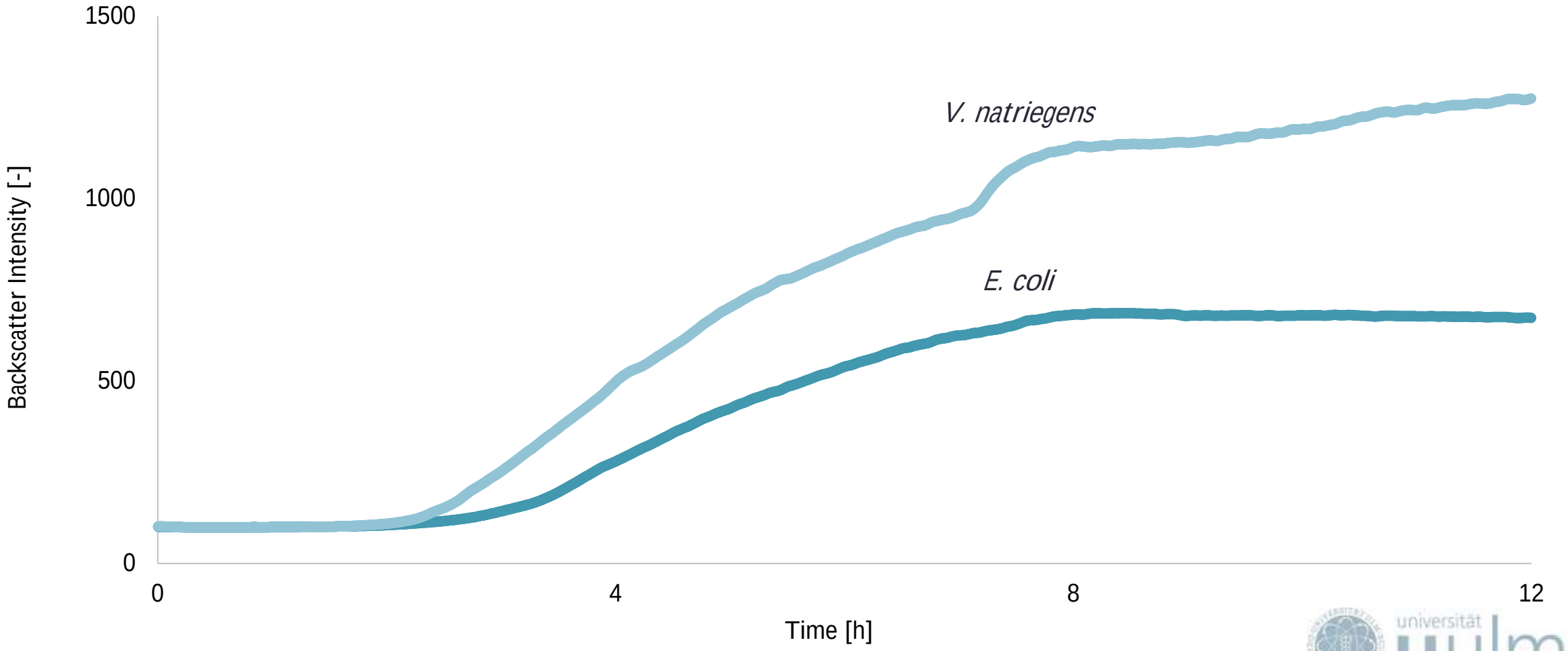
CGQ Measurement (OD Calibrated): *Escherichia coli*



Escherichia coli BL21-Gold (DE3) pET28a(+) EGFP Kan^{R}, 50 ml LB Medium, 500 ml Shake Flask, 37 °C, 250 rpm

The CGQ is ideal for growth rate comparisons of different organisms in shake flasks, for example *Vibrio natriegens* versus *Escherichia coli*.

CGQ Measurements: *Vibrio natriegens* and *Escherichia coli*



Escherichia coli & *Vibrio natriegens*, 25 ml LB Medium (*Vibrio*: + V2 Salts), 250 ml Shake Flasks, 37 °C, 180 rpm

universität ulm

aquilabiolabs

The feedback of CGQ users for is very positive and underlines the value of the CGQ for shake flask experiments.

CGQ User Feedback

The CGQ is the reason why we were able to generate detailed growth kinetics for Sulfolobus.

Prof. Dr. E. Peeters

Vrije Universiteit Brussel

Thanks to the CGQ and the experts from aquila biolabs we have ultimately developed a profound understanding of our bioprocesses.

Dr. H. Tegel

THE HUMAN PROTEIN ATLAS

Thanks to the CGQ we were able to save a lot of time for our manual OD measurements and could run our growth experiments unattended over night.

iGEM Team Aachen

RWTH AACHEN UNIVERSITY

The CGQ is the first device that allows us to monitor microbial growth on this highly complex media.

Dr. H. Aspeborg

KTH