Online monitoring of photobioreactors: development & integration of innovative sensors and probes for optimal process and product control

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RÉSUMÉ

Algae production in Europe is currently limited to a few small industries, mainly for the feed, nutrition and cosmetic sectors. This sector is ripe for further expansion. However, creating an economically viable and sustainable method of growing large quantities of algae with consistent quality and converting them into successful commercial products that the markets accept remains an industrial challenge.

Started up in May 2017, the ABACUS project is a 3-year collaborative initiative funded by BBI JU and the EU under the H2020 programme [1]. It gathers 2 large industries, 3 algae SMEs and 4 RTOs. It aims at a business-oriented and technology-driven development of a new algal biorefinery, thereby bringing to the market competitive and innovative algae-based ingredients for high-end applications, spanning from algal terpenes for fragrances to long-chain terpenoids (carotenoids) for nutraceuticals and cosmetic actives.

The ABACUS workflow associates several interdisciplinary approaches, including the technological development of algae production processes to optimize photosynthetic growth and yields in target metabolites. Online monitoring and automated control of photobioreactors used for algae cultivation is considered as a key to process optimization and secured production of biomass and target compounds.

In addition to classical solutions already implemented at large scale for PBR instrumentation, several innovative probes were developed and adapted to provide online in-process information about biomass growth and content in target compounds. The presentation will provide insight into the development and test of several devices in real cultivation scenarios performed in FPA-PBRs (Figure 1).

An optofluidic system was designed, assembled and tested for detection of microalgal growth and product formation using multiple wavelength readings.

Moreover, an existing electrochemical platform for water analysis was extended with the design of new sensors, adapted electronics and a dedicated software interface for measuring nutrient availability.

For detection of volatile terpenes in PBRs headspace, a portable microGC system integrating a chip based pre-concentration subunit was evaluated.

Commercially available turbidity probes and a newly developed RGB probe were also integrated.

Promising correlations were obtained between probe readings and manually followed growth and target product content.

MOTS-CLES DU THEME

Biotechnologies bleues, Bioréacteurs, Bioressources marines.

MOTS-CLES LIBRES

Sonde, Capteur, Microfluidique, Optique, Contrôle de Procédé

FIGURES

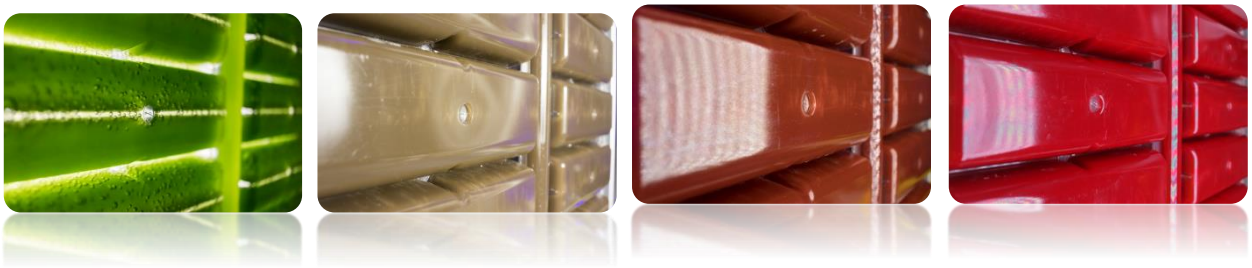

Fig. 1. Cultures of *Haematococcus pluvialis* in transition from vegetative growth (green phase) to astaxanthin accumulation (red phase) in FPA-PBRs.

Fig. 2. Developed/adapted probes
from left to right: RGB, turbidity, optofluidic system, electrochemical platform, preconcentrator chip for microGC.

RÉFÉRENCES

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