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Data Article

Dataset to assess the shadow effect of an outdoor microalgae culture

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ABSTRACT

This data in brief (DIB) article is related to a Research article [1]. Microalgae biomass absorb the light photons that are supplied to the culture, reducing the light availability in the inner parts of the photobioreactors. This is known as self-shading or shadow effect. This effect has been widely studied in lab conditions, but information about self-shading in outdoor photobioreactors is scarce. How this shadow effect affects the light availability in an outdoor photobioreactor was evaluated. In addition, advantages and disadvantages of different artificial light sources which can overcome light limitation are described.

1. Data

This data includes information related to the reduction of light intensity within a microalgae culture and how this reduction varies with the microalgae biomass concentration (Fig. 1). The microalgae close to the surface in a photobioreactor (PBR) absorb most of the photons, restricting the light received in

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Specifications table

Subject area	*Environmental engineering*
More specific subject area	*Wastewater treatment*
Type of data	*Graph and table.*
How data was acquired	*Irradiation sensor (Apogee Quantum SQ-200)*
Data format	*Analysed and raw data*
Experimental factors	*Grab samples of the cultures (in duplicate)*
Experimental features	*Monitoring of solar irradiation and biomass concentration of the culture during the start-up phase*
Data source location	*Valencia, Spain (39°30′04.0″N 0°20′00.1″W)*
Data accessibility	*Data is included with this article*
Related research article	*González-Camejo* et al. [1]

Value of the data

- This data can be used to select the most appropriate artificial light source to cultivate microalgae.
- The shadow effect of a microalgae culture is evaluated under natural conditions.
- A comparison between shadow effect at high and low biomass concentration is presented.
- This data can be useful to reduce the light limitation in outdoor microalgae cultivation systems.

the inner part of the PBR [2]. This is known as shadow effect or self-shading [3,4]. According to Fig. 1, the difference in the solar radiation between PAR-2 (outside of the PBR) and PAR-1 (2 cm away from the front wall) varied with respect to the volatile suspended solids (VSS) concentration, which was used as measurement of microalgae biomass. It started with a biomass concentration of 160 mg VSS·L^{-1} (solar irradiance decreased by 15%) and finished with a biomass concentration of 420 mg VSS·L^{-1}, causing a 71% reduction in solar irradiance (Fig. 1).

PAR-1 was also placed 5 cm from the front wall, at which point light intensity was noticed.

The shadow effect have been previously evaluated in lab conditions, showing significant reductions of light availability in the culture. By way of example, Huesemann et al. [5] reported that light penetration in open ponds becomes critical when microalgae biomass is around 500 mg L^{-1}, while Anbalagan et al. [6] obtained a light reduction from 150 to 7–10 μmol m^{-2} s^{-1} at a depth of 10 cm in a lab-

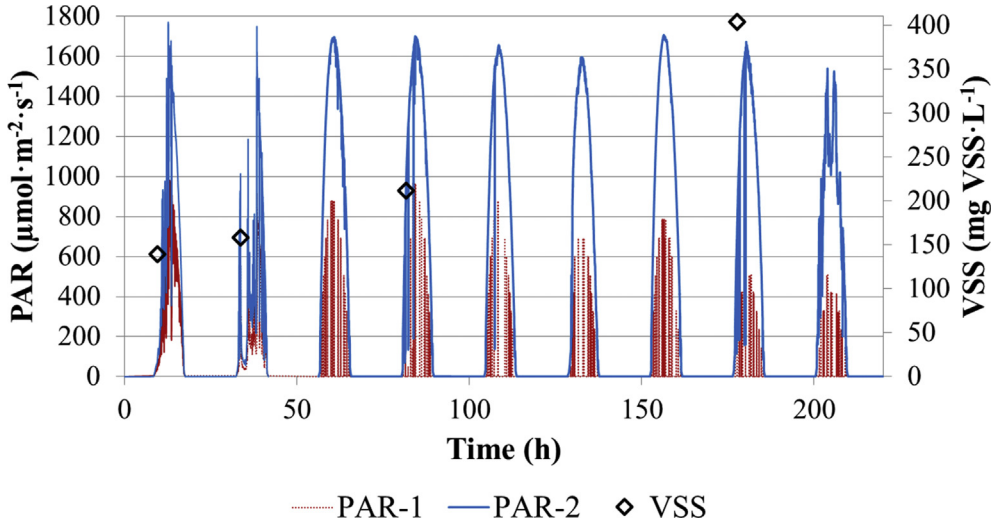

Fig. 1. Evolution of light irradiance inside the culture (PAR-1) and outside the PBR (PAR-2) with increasing volatile suspended solids (VSS) concentration.

Table 1
Advantages and disadvantages of different artificial light sources.

	Advantages	Disadvantages	References
Incandescent light bulbs	• Low cost	• Light emitted in infrared region. • Light radiated in all directions.	[8] [9]
Halogen lamps	• Better energetic efficiency than light bulbs.	• Similar spectrum than light bulbs.	[8] [9]
Fluorescent lamps	• Similar spectrum to daily light.	• More expensive than light bulbs and halogen lamps.	[8]
LED lamps	• Narrow wavelength. • High efficiency. • Long lifespan. • Reduce light stress. • Dissipate less energy.	• High cost.	[3] [8] [10] [11]

scale PBRs with biomass concentrations of around 250 mg L^{-1}. To overcome this shadow effect, additional artificial lighting can be applied to the microalgae culture [7]. Table 1 briefly summarises some advantages and disadvantages of different artificial light sources.

2. Experimental design, materials and methods

In order to assess the shadow effect in the outdoor photobioreactor (PBR) plant [1], an irradiation sensor (Apogee Quantum SQ-200) was placed inside the PBR-A, 2 cm away from the front wall during the start-up phase of Experiment 1 (PAR-1), and another sensor was placed outside the PBR-A (PAR-2) [1].

VSS concentration was measured according to Standard Method 2540-E [12].

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Conflict of interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.dib.2019.104143.

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