BIOFOULING FORMATION ON DIFFERENT POLYMERIC SURFACES UNDER ABIOTIC CONDITIONS OF FLAGELLATED MICROALGAE CULTURE

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INTRODUCTION

Microalgae are photosynthetic microorganisms that produces a wide quantity of products and have different applications One of the problems which the culture of microalgae presents and that greatly increases production costs, is the formation of biofouling on the inner walls of photobioreactors (PBRs), that decreases the penetration of light into the PBR. Finding new materials for the construction of photobioreactors where the formation of biofouling is minimal, could be one of the keys to lower costs and make the production of microalgal biomass a more efficient process.[1]

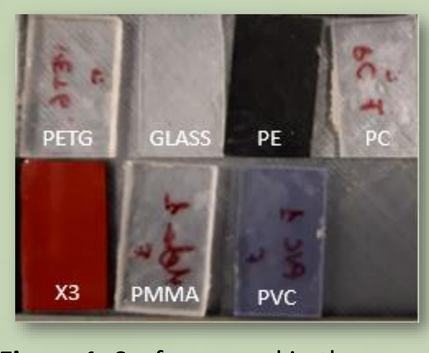
OBJECTIVE

The objective of this work is the characterization of five different commercial polymeric surfaces (PVC, PETG, polyethylene, polycarbonate and methacrylate) and two surfaces used like control (Glass and Hempasil X3®) as well as the study of adhesion of microalgae on these materials which where integrated in the walls and bottom of 250 mL vessels in discontinuous and fed-batch mode. Cultures were subjected to different Nitrogen : Phosphorous ratios as well as two levels of irradiance.

In the study, two different flagellated microalgae were used: *Chlamydomonas Reinhardtii* (the model freshwater microalgae)[2] and Isochrysis galbana (marine flagellated microalgae).

MATERIALS AND METHODS

○ Surfaces



CHARACTERIZATION

- Contact angles mesurement
  - ↳ Surface free energy
- Surface roughness, Ra
- Protein adsorption capacity [3]

Figure 1. Surfaces used in the experiment.

○ Design and construction of stirrer support

The support for a stirrer performed allows monitoring of 24 vessels of 250 mL simultaneously. On the other hand, a controller has been designed and built that allows programming different lighting regimes (ON-OFF and solar cycle), as well as different light spectra (varying the composition of the color of the light).

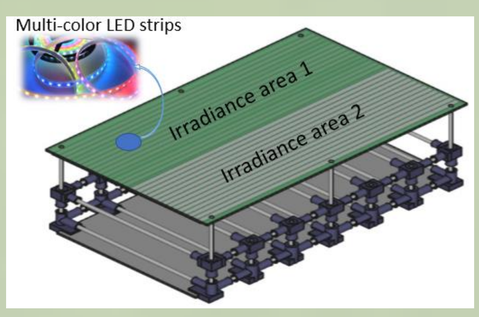


Figure 2. Suport designed for stirrer.

○ FBRs and culture evolution

Figure 3. Experiment ejecution.

- *C. Reinhardtii*
  - N:P 1,29
  - N:P 16
  - NP 35
- *I. Galbana*
  - N:P 7,26
  - N:P 16
  - NP 35

- Characteristics of culture
  - FBRs of 200mL
  - 100 and 400 µE·m^{-2}·s^{-1}
  - 24°± 1°C
  - pH 5 - 7

○ Analysis techniques

- Cell adhesion
  - ↳ Chlorophyll 'a' fluorescence measurement [1]
- Protein adhesion with the culture
- Bacteria Adhesion
  - ↳ Seeding in Petri plates with nutritive agar

RESULTS AND DISCUSSION

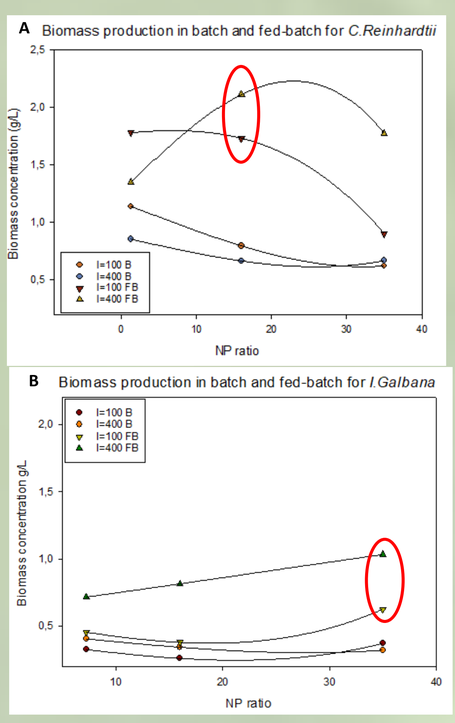


Figure 4. Biomass production for in Batch (B) and Fed-Batch (FB) for both lirradiance levels (100 and 400 µE·m^{-2}s^{-1}) in fuction of N/P ratios for A) C. Reinhardtii; and for B) I. Galbana.

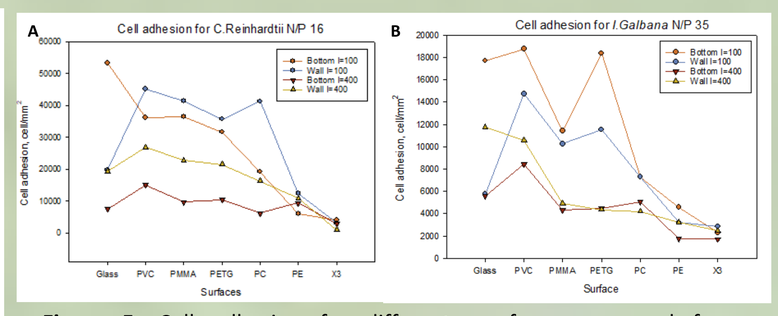


Figure 5. Cell adhesion for differents surfaces measured from Chlorophyll a fluorescence. A) Data of surfaces for FBR with C. Reinhardtii operated at N/P ratio of 16. B) Data of surfaces for FBR with I. Galbana operated at N/P ratio of 35.

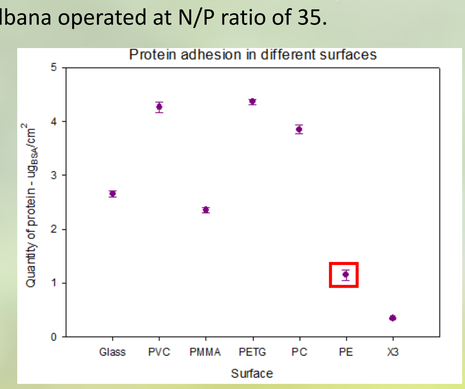


Figure 6. Protein adsorption for differents surfaces.

- For the maximum biomass production culture (Figure 4), it has been chosen for represent the data of cell adhesion. Until **biomass production** has been the **highest** for the irradiance of **400 µE·m^{-2}·s^{-1}**, **cell adhesion** have been **the lowest** in these conditions.
- The previous characterization of surfaces, indicated that the **protein adsorption capacity**[3] in **Polyethylene** was **the lowest** (Figure 6) than in the other ones, **similar to Hempasil X3®**.

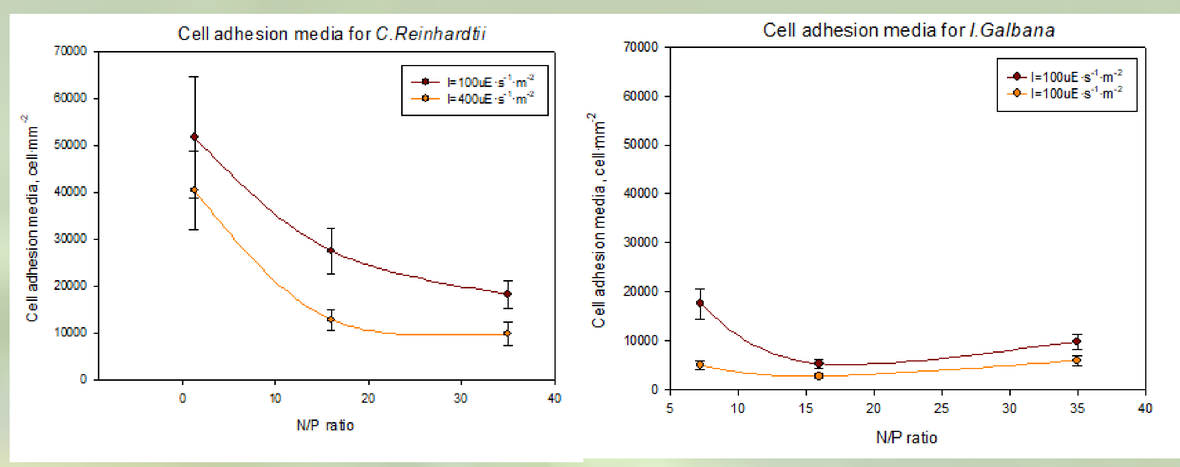


Figure 7. Mean cell adhesion of seven tested surfaces as a function of N/P ratio and irradiance for A) *C.Reinhardtii* and B) *I.Galbana.*

- As NP increases, adhesion decreases in both strains and for the two irradiances tested.
- C. Reinhardtii presents higher cell adhesion values than I.Galbana

REFERENCES

[1] Zeriouh, O., Reinoso-Moreno, J., López-Rosales, L., Sierra-Marín, B., Cerón-García, M., Sánchez-Mirón, A., Fernández-Barbero, A., García-Camacho, F., and Molina-Grima, E. Algal Research. 2017, 23, 240-254.

[2] Kreis, C. T., Le Blay, M., Linne, C., Makowski, M. M., and Bäumchen, O. Nature Physics. 2014, 14, 45.

[3] Wang, D., Wu, X., Long, L., Yuan, X., Zhang, Q., Xue, S., Yan, C., Wang, J., Cong, W. 2017, 33, 970-979

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