Proceedings of the 5th International Conference on Environmental Science and Applications (ICESA 2024)
Lisbon, Portugal- November 18 - 20, 2024
Paper No. 177
DOI: 10.11159/icesa24.177

Hydrogen production via Platymonas subcordiformis in different CO_2 concentration conditions

Marcin Dębowski, Marcin Zieliński, Paulina Rusanowska, Łukasz Barczak, Adam Starowicz, Magda Dudek

University of Warmia and Mazury in Olsztyn, Faculty of Environmental Sciences, Department of Environment Engineering, Warszawska St. 117, 10-720 Olsztyn, Poland
marcin.debowski@uwm.edu.pl; marcin.zielinski@uwm.edu.pl; paulina.jaranowska@uwm.edu.pl; lukasz.barczak@uwm.edu.pl; adam.starowicz@uwm.edu.pl; magda.dudek@uwm.edu.pl

Extended Abstract

Platymonas subcordiformis may be deemed a prospective species in terms of its hydrogen production capacity. Responsible for these biochemical transformations are the transmembrane peptide complexes, namely photosystem I (PSI) and photosystem II (PSII). Light stimulates PSII to produce O_2. Under aerobic conditions, PSI uses the generated electrons to reduce CO_2 and build microalgae biomass, or under anaerobic conditions, via ferredoxin, electrons are transported to hydrogenase and initiate H_2 production. The aim of the study was the determination of the influence of different concentration of CO_2 on microalgae growth and hydrogen production by microalgae *P. subcordiformis*. *P. subcordiformis* was cultivated in two-stages in medium suggested by Guan [1] with the CO_2 ranged from 22 to 220 mg CO_2/L, introduced to the bottom of the reactor. After cultivation, the microalgae biomass was transferred to the medium of composition indicating hydrogen production and conditions of a two-phase incubation. In the first phase, biomass was placed in dark anaerobic conditions for 30 h to hydrogenase induction. Anaerobiosis was achieved by continuous flushing of pure nitrogen through the culture suspension. The second phase of photobiological hydrogen production was then initiated by placing the biomass under continuous light illumination for 5 days. During the experiments amount of produced gases were continuously monitored. After the incubations the composition of biogas was measured.

Similar biomass concentrations of *P. subcordiformis* were obtained in the stationary growth phase irrespective of the CO_2 concentration used in the culture medium, approximately 2800±297 mg VS/L and 64.4±5.1 mg chl-a/L. Significant differences were observed in the proliferation rate of the microalgae in the logarithmic growth phase, which ranged from 194±16 mg VS/(L·day) to 230±11 mg VS/(L·day), depending on the CO_2 concentration tested. Significantly lower values, which characterise the growth efficiency (1940±130 mg VS/L) and kinetics of the process (107±10mg VS/(L·day)), were obtained in the control sample, in which the culture medium was supplied with atmospheric air. In the experimental variants, the highest total H_2 production of almost 140±18 mL was obtained, with an observed H_2 production rate of 5.11±0.19 mL/h. Significantly lower effects in terms of hydrogen production were observed in the control variant.

This work was financed by the Polish National Science Center (Grant Number 2021/41/B/NZ9/02225).

References

[1] Y. Guan, M. Deng, X. Yu, W. Zhang. Two-stage photo-biological production of hydrogen by marine green alga Platymonas subcordiformis. Biochem Eng J 19 (1), 69e73, 2004.