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Effect of light on the production of bioelectricity and added-value microalgae biomass in a Photosynthetic Alga Microbial Fuel Cell

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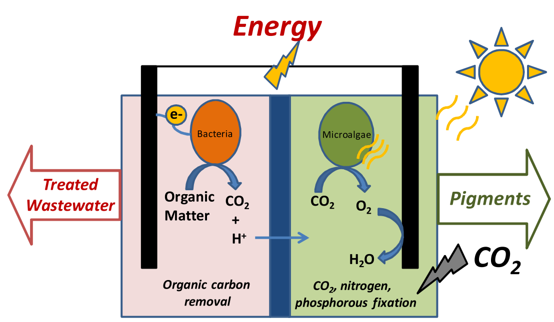
HIGHLIGHTS

- Bioelectricity and value pigments production in a PAMFC.
- A light intensity increase resulted in a consequent increase of the PAMFC power.
- The maximum power produced was 62.7 mW/m^2 with a light intensity of 96 μE/(m^2 s).
- Light intensity and PAMFC operation potentiated the carotenogenesis in the cathode.

GRAPHICAL ABSTRACT



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ABSTRACT

This study demonstrates the simultaneous production of bioelectricity and added-value pigments in a Photosynthetic Alga Microbial Fuel Cell (PAMFC). A PAMFC was operated using *Chlorella vulgaris* in the cathode compartment and a bacterial consortium in the anode. The system was studied at two different light intensities and the maximum power produced was 62.7 mW/m^2 with a light intensity of 96 μE/(m^2 s). The results showed that increasing light intensity from 26 to 96 μE/(m^2 s) leads to an increase of about 6-folds in the power produced. Additionally, the pigments produced by the microalga were analysed and the results showed that the light intensity and PAMFC operation potentiated the carotenogenesis in the cathode compartment.

The demonstrated possibility of producing added-value microalgae biomass in microbial fuel cell cathodes will increase the economic feasibility of these bioelectrochemical systems, allowing the development of energy efficient systems for wastewater treatment and carbon fixation.

1. Introduction

The bioelectrochemical systems, such as microbial fuel cells (MFC) are able to convert the energy stored in any biodegradable substrate directly into electricity. The possibility of using light irradiation to potentiate the production of electricity in MFCs has received increased attention in the last decade, with the development of different systems and concepts capable of converting light into bioelectricity (Rosenbaum et al., 2010). These systems are commonly known as photo microbial fuel cells (PhotoMFCs) and could make use of the cost-free solar radiation to generate energy. Recently, several works proposed the use of photosynthetic microorganisms as biocatalysts, for oxidation and reduction reactions that occur in the anode and cathode compartments of a MFC. Rosenbaum et al. (2010) describes several PhotoMFCs systems. A few works report the use of photosynthetic bacteria for electron production in the anode compartment. Bacteria such as *Rhodopseudomonas* and other purple non-sulfur bacteria have been identified in anode biofilms (Xing et al., 2008). The use of microalgae in MFCs has also been reported both in the cathode and anode compartments. Raman and Lan (2012) described a system where green

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