Hydrocarbon Production of *Botryococcus braunii* in a Photobioreactor: Optimization of Irradiance and Mixing Regimes

Huijun Xu [1], Liang Song [2,3,4,*] and Jianguang Qin [1,2,*]

[1] Southern Marine Science and Engineering Guangdong Laboratory (Guangzhou), 1119 Nansha Street, Nansha, Guangzhou 511458, China
[2] College of Science and Engineering, Flinders University, Adelaide GPO Box 2100, SA, Australia
[3] State Key Laboratory of Marine Food Processing & Safety Control, National Engineering Research Center of Seafood, Collaborative Innovation Center of Seafood Deep Processing, Liaoning Province Key Laboratory for Marine Food Science and Technology, Dalian Polytechnic University, Dalian 116034, China
[4] School of Food Science and Technology, Dalian Polytechnic University, Dalian 116034, China
* Correspondence: ryo.song@foxmail.com (L.S.); qin_jianguang@gmlab.ac.cn (J.Q.)

Supplementary Materials

Technical Description of the Flat Plate Photobioreactor

To produce a large quantity of algae for oil extraction and inoculation in field culture, we designed an algal photobioreactor. The major issue in current static-reactor algal cultivation is poor light distribution in the culture vessel. If light intensity is too high, algal growth is inhibited. However, self-shading occurs among individual cells at a high algal density. Algae at the surface of a static reactor absorb light, leaving those a few millimeters below in darkness.

A key feature of a photobioreactor is ensuring that algae have enough contact with light, air, and nutrients. In the photobioreactor, despite a high biomass concentration, algae can be cultivated in large quantities. A new photobioreactor (flat-plate airlift reactor) was designed with a thickness of only 3 cm and showed a fast algal growth rate in a preliminary trial. This reactor consists of a bubble column with a constant flow of air bubbles and carbon dioxide (Figure S1). This setup supports high-density algal cultures with adequate light.

We studied algal biomass and hydrocarbon production in UTEX572 flat-panel photobioreactors. We compared algal production with photobioreactors reported in other studies to determine whether this photobioreactor type is suitable for producing this type of algae.

Figure S1 shows the structure and design of the flat plate photobioreactor. The reactor system consists of a flat polyvinyl chloride (6 mm thick) reactor chamber measuring 75 cm high, 20 cm long, and 3 cm wide. An airlift connected to the bottom end of the reactor on both sides mixes the algal suspension throughout the system. The air flow rate entering the photobioreactor is regulated using flow meters and setpoints. For mineral nutrition, a peristaltic pump supplies fresh medium to the reactor. Harvesting the algal suspension will be carried out by overflow through the reactor outlet once every 3 days. Figure S2 shows the detailed figures and measurements used to design and manufacture this photobioreactor.



Figure S1. A diagram of the flat plate photobioreactor system.

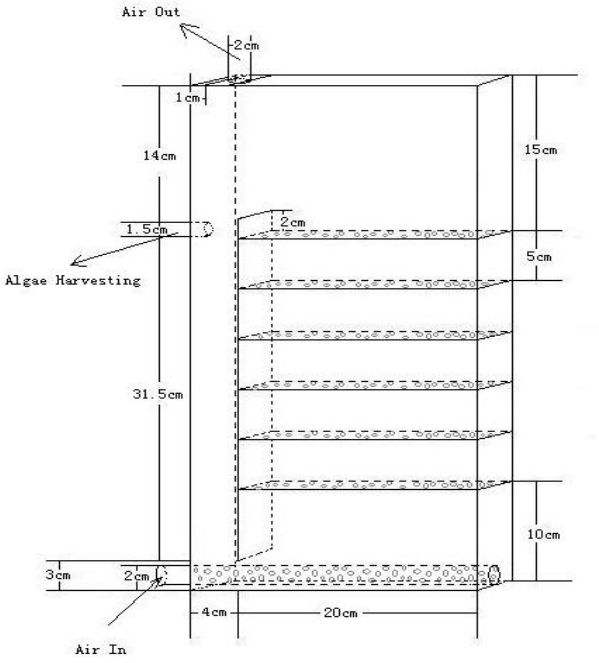


Figure S2. Schematic drawing of a flat plate photobioreactor.