



Application of power plant flue gas in a photobioreactor to grow *Spirulina* algae, and a bioactivity analysis of the algal water-soluble polysaccharides

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HIGHLIGHTS

- ▶ This study is the biggest experimental study of photobioreactor in Taiwan.
- ▶ The photobioreactor was capable of fixing 2,234 kg of CO₂ per annum.
- ▶ The estimated amount of CO₂ to be fixed by a scaled-up reactor would be 74 tons ha⁻¹ year⁻¹.
- ▶ The polysaccharides of *Spirulina platensis* have immunomodulation properties by the induction of cytokines.

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ABSTRACT

A novel photobioreactor was developed with a total volume of 30 m³ which required merely 100 m³ of land footprint. The bioreactor was capable of utilizing CO₂ in the flue gas of a power plant as the carbon source for the growth of a freshwater alga, *Spirulina platensis*, mitigating the greenhouse effect caused by the same amount of CO₂ discharge. Results of the study indicated that the photobioreactor was capable of fixing 2,234 kg of CO₂ per annum. Upon deducting the energy consumption of operating the bioreactor unit, the estimated amount of CO₂ to be fixed by a scaled-up reactor would be 74 tons ha⁻¹ year⁻¹. In addition, the study proved that protein-free polysaccharides of *S. platensis* could induce the production of pro-IL-1 and IL-1 proteins through the mediation of ERK, JNK, and p38 MAPKs pathways. As a consequence, immunogenic activities of the macrophage cells were enhanced.

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1. Introduction

The threat posed by greenhouse gases and global warming to human and natural systems is a worldwide issue, and is deemed as one of the major challenges that nations, governments, enterprises and the general public must resolve in the coming decades. Nations at all socioeconomic levels, as well as various industries, have initiated a multitude of activities – including the sharing

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and exchange of technology, experience and resources – in the hope of decreasing greenhouse gas emissions and thus allaying the threat of global climate change. As early as 1977, Marchetti proposed capturing carbon dioxide in the deep ocean (Marchetti, 1977). Since that time, a variety of methods have been proposed for the sequestration of atmospheric carbon dioxide. Many countries have joined in an international effort to mitigate the greenhouse gas problem through the IEA Greenhouse Gas R&D Programme, in which biofixation technology using microscopic algae has been tapped as an important strategy for fixing carbon dioxide and thus reducing emissions (Kumar et al., 2011). The Taiwan Power Co. (Taipower) uses mainly fossil fuels (including oil and coal) as energy sources for generating electricity. Since burning fossil fuels produce