PHYSICAL CHARACTERISTICS OF *PLEUROCHRYSIS CARTERAE* IN RELATION TO HARVESTING POTENTIAL FOR BIODIESEL PRODUCTION

By

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Declaration

This work contains no materials which have been accepted for the award of any other degrees or diploma in any university or other tertiary institution, to the best of my knowledge and belief and contains no material previously published or written by another person, except where due reference has been made in the text.

I give consent for this copy of my thesis to be made available in the University Library.

Marjan Rahbari

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Abstract

During the last three decades, microalgae has been suggested as a potential source of biofuel, with a number of advantages over other energy crops. These advantages, including high lipid content, fast growth rate, reduced requirements for land and the possibility of utilizing marine water systems constitute the most likely sources for CO_2 reduction systems. However, no commercial plant has been established to date. This is because of the high capital cost of microalgal systems and the many uncertain aspects of harvesting small cells (<20µm) from dilute cultures (~1g/l). Therefore, this project aims to investigate the physical characteristics of *Pleurochrysis carterae*, a potential biofuel feedstock, with a view to understanding the fundamental characteristics of this species during large-scale harvesting.

The preliminary study of cell growth cycle in the laboratory showed that; *P. carterae* grows quickly in BG11 media with 1.8% salinity. The maximum cell concentration after 20 days was ~0.5 g/l. Also, large flocs (120µm) were observed early in the growth phase (day 4) and the stationary phase (day20).

In order to calculate the theoretical settling rate some parameters, such as cell size distribution and medium viscosity, were measured. The results indicated that cell size grew from 3.8µm at the inoculation to 11.7 µm at the end of the growth cycle. Also, the viscosity of the suspension was independent of cell concentration and is identical to that of seawater (0.001Pa.s). The theoretical settling rate, based on Stokes' law yielded, 1.4×10^{-6} m/s. Screen tests from column settling tests showed that the terminal selling rate of *P. carterae* cells is 4×10^{-4} m/s, which is faster than the predicted rate. It was estimated that 91% of cells, without any pre-treatment, and during 12 hour experiments, settled to the bottom of the columns. It shows flocculation is a potential method for a low cost harvesting in large scale biomass production.

The effect of shear stress on cell viability after centrifugation with various gravity forces was also assessed. The results showed that the number of broken cells

increased at higher shear stress and that maximum cell disruption occurred after harvesting with 11000 × g force.

Results from laboratory in this study indicate that further optimisation need to be done to increase *P. carterae* harvesting efficiency toward the minimum cost, thus achieve economic biodiesel product.

P. carterae is a potential candidate for commercial scale biofuel production with significant advantages including high growth rate, low contamination risk and fast settling velocity. The use of a primary flocculation stage with secondary continuous centrifugation is potentially suitable for low cost commercial harvesting. However, still more work needs to be done to demonstrate the feasibility of large-scale production of biofuel from microalgae.