Studies on the effect of different light intensity and CO_2 concentration towards *Chlorella sp.* growth using Palm Oil Mill Effluent (POME)

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Carbon dioxide (CO_2) is a major gas that lead to global warming. CO_2 sequestration by microalgae has been extensively studied recently since it is able to utilize CO_2 for photosynthetic activity and has higher production rate as compared to plant. Malaysia produced large amount of palm oil mill effluent (POME) every year and its contain high nutrient that was potentially act as medium for microalgae cultivation. The growth of *Chlorella sp.* in POME medium was investigated in this study under different CO_2 concentrations (5% (v/v) to 20% (v/v)) and light intensity (ranging from 900lux to 12000lux) for 7 days. The effect of both factors on microalgae growth or CO_2 fixation was evaluated through dry cell weight of biomass during the entire growth period. The biomass yield increased with increasing the CO_2 concentration and declined after reaching peak CO_2 concentration it cause decreased in pH value of the medium. Additionally, increasing the light intensity also increased the biomass yield as it enhances the photosynthetic rate. However, excessive light intensity lead to photo inhibition whereas low light intensity cause growth limiting. The result obtained from optimization using the Design Expert software showed that CO_2 concentration, light intensity, their interaction effect and the squared CO_2 concentration term gave significant effect to the CO_2 fixation by microalgae. The optimum value of 10.91% (v/v) CO_2 concentration and 9963.85 lux of light intensity were verified to able to maximize CO_2 sequestration. The results of this study have verified that POME could support good growth of microalgae species and their potential to sequester carbon dioxide.

Keywords— *microalgae, Chlorella sp., carbon dioxide, light intensity, CO_2 fixation*

1. INTRODUCTION

Recently, global warming has become the big issue to the whole world. This is caused by industry revolution and one of the major gases that lead to global warming is carbon dioxide (Campbell *et al.*, 2006). A lot of CO_2 mitigation strategies have been investigated, for example direct injection of CO_2 into geologic, oceanic sinks, chemical absorption, membrane separation and molecular sieve (Stewart & Hessami, 2005). Among those methods, biological method has attracted most attention among the researchers. One of the biological methods that recently have been studied to reduce the level of CO_2 is by using of microalgae to sequester the CO_2. Researchers are interested in microalgae as the alternative because of its potential for high production regardless of season and their utilization of CO_2 in large quantities during growth (Singh *et. al*, 2010). Besides, it was reported that algae are more efficient in utilizing sunlight and higher growth rate than terrestrial plants (Chisti, 2007). In addition, short time is needed to grow the microalgae as compared to growing plants. Most importantly, majority of the microalgae could produce useful products, which has become value added to the process (Brennan & Owende, 2010). Therefore, microalgae have been seen as a better solution to sequestrate CO_2.

Microalgae is the fast growing microorganisms with an ability to fix CO_2 from atmosphere, flue gases or soluble carbonate while capturing solar energy with efficiency 10-50 times greater than the terrestrial plants (Khan *et al.*, 2009). The best method for microalgae to act as carbon sink is capture CO_2 from the atmosphere for its growth; however this method is limited by low CO_2 concentration in the air (Brennan and Owende, 2010) which make it economic infeasible. This is further hindered by the low mass transfer rate of CO_2 in water and thus, higher air pumping cost is required. On the other hand microalgae have a better adaptability to high concentration of CO_2 up to 20% from flue gases emission (Brennan and Owende, 2010). Moreover, only a small number of microalgae strains are able to tolerate high level of SOx and NOx that are present in flue gases (Brennan and Owende, 2010). In other words, there is still a huge potential to utilize flue gases from palm oil mill to culture microalgae coupled with POME as nutrients source, that can be easily found in tropical countries like Malaysia