CO₂ Reduction and Production of Algal Oil Using Microalgae Nannochloropsis oculata and Tetraselmis chuii

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This research concerns about reduction of CO₂ and production of algal oil using microalgae Nannochloropsis oculata and Tetraselmis chuii. The objectives are to determine the ability of the microalgae in reducing CO₂ during photosynthesis and also to produce biomass for algal oil. The CO₂ in air was fed into photobioreactor with concentration of 3, 6, and 9 % and light intensity of 360 and 1250 lumen. The CO₂ concentration output was analysed to determine the reduction of CO₂ during photosynthesis. The microalgae was harvested in 5 days and then it was extracted to obtain algal oil. The results show that both CO₂ concentration and light intensity affect the CO₂ reduction significantly. The higher the CO₂ input and light intensity the higher the reduction of CO₂ for both algae. Therefore, the best condition within the range of this research is at the CO₂ concentration of 9% and light intensity 1250 lumen which gives reduction of CO₂ 49.5 %. The extraction gives yield of algal oil 11.37 % and 9.50 % for both Nannochloropsis oculata and Tetraselmis chuii, respectively.

1. Introduction

Global warming is one of the hottest global issues because the big impact on our universe and environment. By definition, global warming is an increase in the average temperature of the earth's atmosphere, especially a sustained increase sufficient to cause climatic change. One the cause is Carbon Dioxide (CO₂) as much as 75 % contribute to Green House Gases (GHGs). Other gases methane (CH₄) 18 %, Ozone (O₃) 12 % and chlorofluorocarbon (CFC) 14 %. The CO₂ is actually not toxic, but because of the increase of the quantity it becomes dangerous to the GHGs and environment. This is due to the development of industries and transportation, as the increase of energy demand. A research in Jakarta showed that vehicle contribute to air pollution of CO₂ 98.80 %, NOₓ 73.40 %, and HC 88.90 %. As the energy demand increased, the nations look for alternative energy such as biogas, bioethanol, biodiesel which lessen the CO₂ emission. One of ways to produce biofuel is utilising green alga which in the same time reducing CO₂ by consuming it during photosynthesis, fotosintesis. For example, Nannochloropsis oculata and Tetraselmis chuii. These are microalgae which can be
Figure 1: Skematic diagram of experimental rig
3. Results and discussions

Reduction of CO$_2$ was observed daily for 5 days during the growth of lagae in the photobioreactor. The percentage of reduction is calculated from the concentration of inlet and outlet gas. The concentration profile is shown in Figure 2.

![Figure 2: Reduction of CO$_2$ at various CO$_2$ input concentration constant light intensity of 360 lumen](image)

The figure shows the reduction of CO$_2$ daily with inlet concentration of 3, 6, and 9 % of CO$_2$-air mixture. Light intensity was constant at 360 lumens. As shown in the figure, the reduction is increased up to 36.547 %. A similar trend is shown in Figure 3 for the same inlet concentration of CO$_2$ at constant light intensity of 1250 lumens. The reduction is increased up to 49.5 %. From the figures it can be seen that the input concentration of CO$_2$ have significant effect on the reduction of CO$_2$. The higher the input of CO$_2$ concentration, the higher the reduction of CO$_2$. The reduction of CO$_2$ are 18.2 % and 36.55 % for 3 % and 9 % inlet concentration, respectively.

![Figure 3: Reduction of CO$_2$ at various CO$_2$ input concentration with constant light intensity of 1250 lumen](image)
A similar trend is observed in Figure 3 where the reduction of CO\textsubscript{2} is increased with increased of CO\textsubscript{2} concentration. The reductions are 25.01% and 49.45% for 3% and 9% inlet concentration of CO\textsubscript{2}, respectively. *Nannochloropsis oculata* and *Tetraselmis chuii* grow by splitting cells. When enough CO\textsubscript{2} is available, the split of algal cells occur faster. As a result, the algae consumes more CO\textsubscript{2}. Beside the CO\textsubscript{2} inlet concentration, light intensity also affect the CO\textsubscript{2} reduction. Two light intensities of 360 and 1250 lumens were applied. Figure 3 shows the CO\textsubscript{2} reduction at fixed input CO\textsubscript{2} concentration of 9%. As can be seen, higher light intensity gives more reduction of the CO\textsubscript{2}. Light intensity of 1250 lumens can be reduced the CO\textsubscript{2} up to 49.49% in comparison to only 36.55% for light intensity of 360 lumens. Similar trend is shown for fixed CO\textsubscript{2} input of 3 and 6%.

![Figure 4](image4.png)

*Figure 4. The effect of CO\textsubscript{2} input on CO\textsubscript{2} reduction*

![Figure 5](image5.png)

*Figure 5: The effect of light intensity on CO\textsubscript{2} reduction*
4. Extraction of Algal Oil

After growing the algae, it then harvested and extracted to obtain algal oil. Extraction was carried out using hexane with immersion method. The results show that algal oil extracted was only 0.83 mL from 7.3 mL algal paste. This means that extracted algal oil is only 11.73%. The extraction need to be improved by using different solvent such as ethanol or by changing algal phase that is dried alga instead of algal paste.
5. Conclusions

Reduction of CO₂ is affected by both input CO₂ concentration and light intensity. Increasing of both input CO₂ concentration and light intensity also increases reduction of CO₂ at the range of variable in this research. Extracted algal oil is only 11.37 %.

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