

## ABSTRACT

Vangga Deswanto Prasetyo Kurniantoro, 24020222120016. **Optimization of Carbon Uptake Efficiency and Lipid Production in *Nannochloropsis oculata* in an Alkaline Medium** (under the guidance of Hermin Pancasakti Kusumaningrum and Irfan Anwar Fauzan).

The continuous increase in atmospheric CO<sub>2</sub> emissions has stimulated the development of carbon capture and utilization (CCU) technologies that integrate carbon capture with biomass production and the generation of value-added products. *Nannochloropsis oculata* is a promising microalga for CCU applications due to its ability to utilize inorganic carbon and accumulate substantial amounts of lipids. This study aimed to determine the optimum alkaline medium conditions for enhancing biomass productivity, carbon uptake efficiency, and lipid production in *N. oculata*. Cultivation was conducted in F/2 Guillard medium at pH levels of 7, 8, and 9 adjusted with NaOH, with and without pre-aeration treatment. Microalgal growth was evaluated based on dry biomass, specific growth rate ( $\mu$ ), and maximum specific growth rate ( $\mu_{max}$ ). Carbon uptake efficiency was evaluated through changes in bicarbonate concentration using the Warder titration method, while lipid content was determined using the Bligh and Dyer extraction method. Data were analyzed using two-way analysis of variance (ANOVA), Tukey's honestly significant difference (HSD) test at  $\alpha = 0.05$ , and Principal Component Analysis (PCA). The results showed that treatment 9A, consisting of pH 9 with pre-aeration, yielded the highest biomass concentration of  $\pm 0.50 \text{ g L}^{-1}$ , the highest specific growth rate of  $0.173 \text{ day}^{-1}$ , and the greatest reduction in bicarbonate concentration of 89.47 ppm. The highest maximum specific growth rate of  $0.504 \text{ day}^{-1}$  was recorded in treatment 7A, whereas treatment 9N resulted in the highest lipid content of 52.5%. Principal Component Analysis revealed positive correlations among biomass, specific growth rate, and bicarbonate concentration, whereas lipid content exhibited an inverse relationship with growth-related parameters. Overall, an alkaline medium at pH 9 represented the optimum condition for supporting growth, carbon uptake efficiency, and lipid production in *N. oculata*.

*Keyword: Biomass, CCU, Lipid, Nannochloropsis oculata*