Effect Of Carbon Dioxide Concentration On Biomass And Abundance Of Chaetoceros Calcitrans Microalgae Cells

Gilbert Turnip, Endang Yuli Herawati, Sri Andayani

Abstract: Chaetoceros calcitrans has a big role in providing feed for larvae, especially shrimp larvae in the field of aquaculture and fisheries. That is because C. calcitrans has a high nutrient content, namely 35% protein, 6.9% fat, 6.6% carbohydrate and 28% ash content (6). Besides in the field of aquaculture and fisheries. C. calcitrans also has a role in humans. C. calcitrans microalgae has high potential as a producer of high economic value chemical compounds such as omega fatty acids. Therefore this study was conducted to determine the biomass and abundance of C.calcitrans microalgae cells in cultivation with the use of carbon dioxide gas. In this study the carbon dioxide concentration injection was used ie 10%, 20%, 30%, and 40%. The highest abundance and biomass of microalgae cells is in the treatment of 10% carbon dioxide concentration,. So for the cultivation of Chaetoceros calcitrans microalga it is recommended to use 10% carbon dioxide injection concentration.

Index Terms: Microalgae, C. calcitrans, Carbon dioxide

1 INTRODUCTION

Microalgae is a prokaryotic or eukaryotic microoraniganism that can photosynthesize and can grow rapidly under difficult conditions (1). All types of microalgae have a chemical composition of cells that consists of proteins, nucleic acids, carbohydrates and lipids. Microalgae also contains organic ingredients such as polysaccharides, hormones, vitamins, minerals and also secondary metabolite compounds (2). Utilization of microalgae, in the field of pharmacology includes antibacterial, antioxidant, antifungal, and antiviral (3). Microalgae has also long been known as a source of protein in shrimp or fish larvae cultivation (4). One way to produce large quantities of marine microalgae biomass is through cultivation. Microalgae cultivation can be done with several levels ranging from small scale to mass scale. Sea microalgae is predicted to be able to accumulate CO_2 (carbon dioxide) in the atmosphere because it has a high growth rate on a medium that has CO_2 solubility and is capable of photosynthesis (5).Chaetoceros calcitrans has a big role in providing feed for larvae, especially shrimp larvae in the field of aquaculture and fisheries. That is because C.calcitrans has a high nutrient content, namely 35% protein, 6.9% fat, 6.6% carbohydrate and 28% ash content (6). Besides in the field of aquaculture and fisheries Chaetoceros sp. also has a role for humans. Microalgae Chaetoceros sp. Has high potential as a producer of high-value chemical compounds such as omega fatty acids. Therefore this study was conducted to determine the ability to grow microalgae Chaetoceros sp. In cultivation with the use of carbon dioxide gas

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2 MATERIAL AND METHOD

In this study the carbon dioxide concentration injection was used ie 10%, 20%, 30%, and 40%, with the following research steps:

Culture Media

The medium used as a culture medium for growth of Chaetoceros calcitrans is Walne medium. The media is first diluted to make it easy to culture.

Pure Culture

The step of pure culture medium:

1. Prepare the medium and culture equipment (containers, air tubes, lid containers) and then sterilize it first.
2. Pure stock of Chaetoceros calcitrans is put into a clean container and mixed with its growth medium. Comparison between the amount of Chaetoceros calcitrans stock with the medium can be adjusted according to research needs. This removal must be kept clean in order to minimize contaminants. Then the culture medium is bubled using an air compressor. At this stage light should also be given but with an intensity of ± 5000 lx.
3. Breeding is done for one week or more if it aims to increase the existing stock, but if only to pass the lag time can be done for 2-3 days or ± 60 hours, depending on the number of cells.

Naming the Microalgae Inoculum

In naming the seedlings the initial cell density used was $1x10^6$ cell/mL. The step to get the initial density calculated by the dilution formula. (7)

Microalgae Cultivation

This cultivation uses a 2 liter volume container of 20 pieces. With a working volume of 1.6 liters using a modified walne medium below 200°C and using white lights with a light intensity of 150µmol. Light intensity is measured using a light meter. The species used was Chaetoceros calcitrans with the same initial density of $1.0x10^5$cell/ml (8), then included sterile sea water and microalgae seedlings by comparison of sterile sea water and microalgae seedlings, initial pH was 7 (9)

Calculation of Cell Abundance

Calculation of microalgae cell abundance from each glass jar in the study is carried out every day. Calculation of cell abundance using a haemacytometer and microscope. Microalgae abundance was calculated using the Improved Neubaeur Haemacytometer formula as follows:

Abundance (cell/ml) = N× $\frac{22}{5}$×10^4.....(1)

Note:

N = Number of cells observed

3 RESULTS AND DISCUSSION

Abundance of Microalgae Cells

The results of the abundance of microalgae cells with different concentrations of carbon dioxide can be seen in Figure 1.

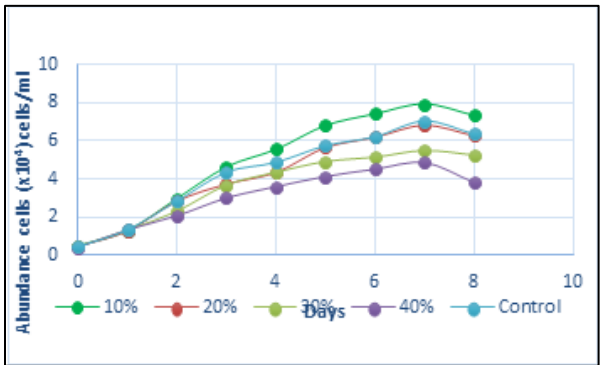

Fig 1. *Abundance Cells of Microalgae (x10^4) cells/ml*

In Fig 1 it can be seen that the average abundance of cells in all treatments reaches the highest value on day 7 and decreases on day 8, on day 7 the highest value is the treatment of 10% carbon dioxide concentration with cell abundance reaching 7.92x10^4 ± 2,19 cell/ml, while the lowest yield on day 7 is treatment with 40% carbon dioxide concentration with cell abundance reaching 4.84x10^4 ± 2,02 cells / ml. Carbon dioxide with 1-2% content is sufficient to be used in microalgae culture with low light intensity. Excessive CO_2 levels cause the pH to be less than the optimum limit needed by microalgae so that it will affect the growth of microalgae (10)

Microalgae Biomass

The results of biomass (dry weight, wet weight, and water level) of microalgae can be seen in Fig 2,

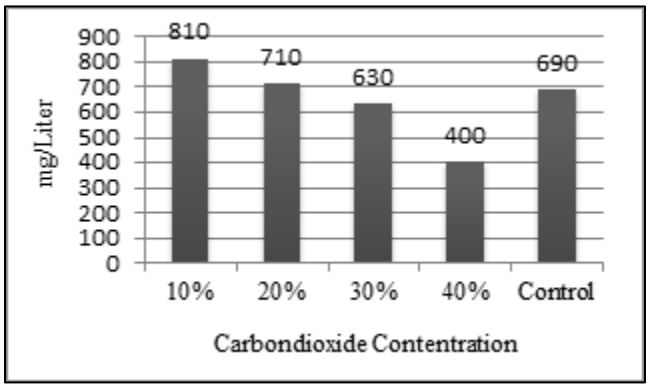

Fig 2*. Biomass of Microalgae (mg/Liter)*

In the picture above, it can be seen that the largest biomass at 10% carbon dioxide injection concentration is 810 ± 0.14 mg/L, while the lowest biomass at 40% carbon dioxide injection concentration is 400 ± 0.16 mg/L. Microalgae achieve maximum growth due to an optimum CO_2 concentration (11). Giving too much carbon dioxide aeration can inhibit the growth of N. oculata, due to conditions that are too low pH (12). Excessive CO_2 levels can cause pH to be less than the limit, this will affect the metabolism and growth of T. chuii, including changing the balance of inorganic carbon, cell physiology, and availability of nutrients in maintenance media (9).

4 CONCLUSION

The highest abundance and biomass of microalgae cells is in the treatment of 10% carbon dioxide concentration,. So for the cultivation of Chaetoceros calcitrans microalga it is recommended to use 10% carbon dioxide injection concentration.

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