Effect of Potassium Nitrate on Growth and Oil Content of Microalgae *(Nanachloropsis sp.)*

MMW Lasanthika, TN Ammon and CP Rupasinghe
Department of Agricultural Engineering, Faculty of Agriculture, University of Ruhuna

Abstract

The production of biofuel from microalgae is motivated with increasing demand for and price of the fossil fuel and emission of the greenhouse gases. Microalgae have high potential to produce oil yield than the other oil seed crops. In Sri Lanka, only few studies have been conducted to produce biofuel from microalgae. The objective of the study was to find out the effect of Potassium nitrate (KNO_3) on the growth and oil content of microalgae. The experiment was performed in outdoor conditions. The microalgae were grown in Guillard and Ryther's modified F medium with different concentrations of KNO_3. The well grown microalgae were harvested and dried under sunlight. Dry matter yield and oil content of each sample was estimated. The effects of KNO_3 concentration on dry matter content and oil content of microalgae were significantly different. The highest dry matter yield and highest oil content of microalgae were observed in 0.101g/L and 0.707g/L of KNO_3 concentrations, respectively compared to the Guillard and Ryther's modified F medium.

Keywords: Dry matter yield, microalgae, oil content, Potassium Nitrate (KNO_3),

Introduction

The basic sources of energy are petroleum, coal, natural gas, hydro and nuclear. Petroleum diesel combustion is a major source of greenhouse gases and air contaminants including NO_x, SO_x, CO and volatile organic compounds. Biodiesel is one of the alternative fuels obtained by the transesterification of triglyceride oil with monohydric alcohol. Biodiesel is a nontoxic and biodegradable alternative fuel obtained from renewable sources.

Algae are one of the best sources of biodiesel. It can produce up to 250 times of oil content per acre compared to soybeans (Shariff *et al.,* 2008). The best algae for biodiesel production is microalgae. Microalgae have much more oil than macroalgae and it grows faster and easier. Microalgae were proven to be attractive ways to produce biofuel due to their ability of accumulating lipids and their very high actual photosynthetic yield (Shariff *et al.*, 2008).

Production of biofuel using microalgae offers many advantages such as higher photosynthetic efficiency than other biomass sources, higher growth rates than terrestrial biomass, ability to survive over a wide range of environmental conditions, ability to utilize waste water sources, no harm with the food chain, ability to synthesize and accumulate large quantities of neutral lipids or oil, not require herbicides or pesticides application and ability to produce value-added co-products or by-products etc. (Jasvinder and Sai, 2010).

With the increasing population, there is a constraint to use edible crops such as sugarcane, maize, and wheat as sources of biofuel production. Today the world is changing for environmental friendly green technologies. Scientists and technologists are motivated to find out alternative sources of biofuel. As a result, possibilities of utilizing microalgae as an alternative source of biofuel are investigated. But very few studies have been conducted on biofuel production from microalgae in Sri Lanka. The objective of the study

was to find out the effect of concentration of KNO_3 on the growth and oil content of microalgae.

Materials and Methodology

The experiment was conducted in the Department of Agricultural Engineering, Faculty of Agriculture, University of Ruhuna. The Guillard and Ryther's modified F medium was selected as the medium for microalgae cultivation (Ammon *et al.,* 2011). The pure culture of *Nanachloropsis sp.* was inoculated into 10 ml of culture medium and it was transferred into 100ml, 1L and 5L of culture media, respectively when the color of culture medium was changed into dark green. The samples were kept under indoor conditions up to 1L stage. After the culture medium was transferred into the 5L stage, the samples were transferred into outdoor conditions and the experiment was commenced. There were five treatments with three replicates and the randomized complete block design was applied as experimental design. According to available literature, KNO_3 was selected as K source (Hegazi *et al.,* 2011). The 1mol/L KNO_3 stock solution was prepared by dissolving 101g of KNO_3 in a volumetric flask and the volume was increased up to 1L according to the way of Guillard and Ryther's modified F medium was prepared by using 84g of $NaNO_3$ (1mol/L). Four different concentrations of KNO_3 (i.e: 0.101g/L, 0.303g/L, 0.505g/L and 0.707g/L) used as treatments and the Guillard and Ryther's modified F medium was used as control. The KNO_3 was added to the samples at twice. The well grown microalgae were harvested using $FeCl_3$ and dried under sunlight. Oil content of each sample was extracted using soxhelt unit. The dry matter yield and the oil content of each sample were estimated. The results were analyzed using SAS version 9.1.3. version.

Results and Discussion

The effect of concentrations of KNO_3 on dry matter yield of microalgae was significantly different compared to the control. The highest and the lowest dry matter yield of microalgae were observed in 0.101g/L and 0.707g/L of KNO_3 concentrations, respectively compared to the control.

The different concentrations of KNO_3 on oil content of microalgae were significantly different. The oil content of microalgae at higher concentration of KNO_3 (0.707g/L) was significantly higher than that of other concentrations. There was no significant difference among other treatments (Figure 1). The highest and lowest oil content of microalgae were observed in 0.707g/L and 0.101g/L of KNO_3 concentrations, respectively compared to the control. Moreover, the highest oil content and the lowest dry matter yield were observed at 0.707g/L of KNO_3 concentration. The highest dry matter yield and the lowest oil content of microalgae were observed at 0.101/L of KNO_3 concentration (Figure 1). There was a positive relationship between oil content and KNO_3. There was no relationship found between dry matter yield and KNO_3 concentrations.

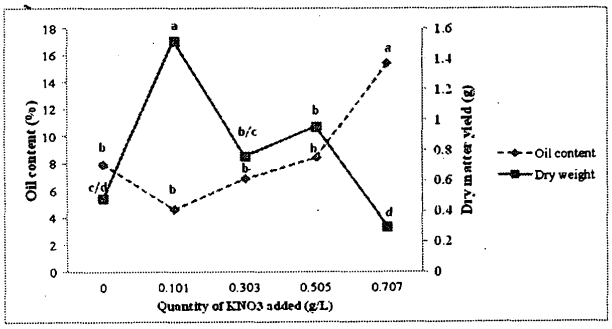

Figure 1. Dry weight and oil content of microalgae with different concentrations of KNO_3 Different letters along a line differ significantly at $P < 0.05$)

The oil content of microalgae increased with decreasing dry weight. The highest percentage of oil content was recorded at the lowest dry matter yield of microalgae compared to the control. Therefore, negative relationship was observed between oil content and dry matter yield.

Conclusion

The increasing concentration of KNO_3 on oil content of microalage was significant. The highest dry matter yield and the highest oil content of microalage were observed at 0.101g/L and 0.707g/L of KNO_3 concentrations, respectively compared to the control. Futher experiments should be conducted to assess the impact of KNO_3 concentrations higher than 0.707g/L on the oil content of the microalgae.

References

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