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# Growth and Purifying Capacity Study of the Green Microalgae in Closed System using Wastewater

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## ABSTRACT

Municipal wastewater (MWW) provides a high potential platform for Microalgae cultivation owing to its abundant load of essential nutrients. Extensive researches have demonstrated the performance properties of the green microalgae to grow and remove different types of pollutants from wastewater; in an ecological and at low-cost manner. Within this framework, MWW was used as growth medium for evaluating the growth parameters and nutrients and COD removal of a green microalgae. Experiments were conducted in closed system (photobioreactors) under batch mode within 10 days. As results, high specific growth rate of 0.55 $day^{-1}$ was achieved, as well as cell density and biomass concentration obtained at the stationary phase were; 6.06 $10^7$ cells\mL and 1.2 g\L, respectively. Final pollutants concentration were reduced to be less than the limit imposed by standard regulation.

**Keywords**: Green microalgae, growth parameter, purifying capacity, municipal wastewater.

## 1 Introduction

The expansion of the global population results in a higher need for resources such as clean water, food, energy, and technology. Consequently, this leads to a rise in the volume of wastewater emissions from both urban and industrial origins. These broad types of wastewater contain diverse organic and inorganic substances, which can pose significant environmental challenges if they are discharged without proper treatment [1]. Conventional treatment systems tend to be costly, require significant energy consumption, and frequently fall short in addressing all the difficulties posed by the generated wastewaters [2]. Microalgae show great potential as a viable option for reclaiming wastewater due to their ability to effectively decrease nitrogen, phosphate, and various harmful substances like heavy metals or pharmaceuticals [3]. Moreover, this approach is not only cost-effective but also environmentally friendly, emphasizing its potential as a sustainable solution. In this context, the usage of a locally isolated green microalgae for the tertiary treatment of MWW was conducted in this study, in addition, the evaluations of the growth parameters such as, specific growth rate, doubling time, and biomass production of the microalgae tested in closed system (photobioreactor), under batch mode and controlled conditions were also performed in this work.

## 2 Experimental

The trials were performed in specially designed photobioreactors using borosilicate glass reactors (3L) for cultivating microalgae (Fig.1). At the beginning of each experiment, a volume of MWW was combined with an axenic algal suspension at a rate of 15% and introduced into the bioreactors. Municipal wastewater (MWW) used in this study was obtained from a local Algiers Municipal Wastewater Treatment Plant, and had undergone preliminary pretreatment through autoclaving. The experiments were carried out in a batch mode, with controlled conditions.



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**Table I:** *"Analysis Parameters and Methods, along with Apparatus Used in the Study"*

| Parameters | Analytics Methods & Apparatus |
|---|---|
| Cell density (cell\mL) | Cell counting (hemocytometer+ Microscope) |
| Biomass concentration (g\L) | Gravimetric ( Filtration system) |
| Ammonium, Nitrate, Orthophosphate (ppm) | Molecular absorption spectrometry (DR 6000 spectrophotometer HACH) |
| Chemicals oxygen demand (ppm) | APC 500 COD, (AP3900 robot HACH). |
| Specific growth rate ($day^{-1}$), doubling time (day) | Equations of (Godoy-192 Hernández and Vázquez-Flota, 2012). |

## 3 Results and Discussion

This study aimed to evaluate the growth potential of the selected green microalgae and their purifying capacity in terms of removing inorganic nutrients and COD from MWW. During the exponential stage, the green microalgae exhibited a specific growth rate of 0.55 day-1, indicating a rapid growth rate. The doubling time, was calculated to be 1.259 days. This indicates that the microalgae were able to proliferate and increase their biomass considerably within a relatively short period. Regarding pollutants reduction, Figure 1. Illustrates the removal efficiency of $N–NH_4^+$, $N–N0_3^-$, $P–PO_4^{-3}$, and COD. The results indicate a significant decrease in nutrient and COD concentrations. Within a span of 3 days, over 80% of ammonium, nitrate and COD were successfully removed. Additionally, after 5 days of cultivation, $P–PO_4^{-3}$ was entirely removed from MWW. These findings highlight the effectiveness of the microalgae cultivation in efficiently reducing nutrient and COD levels in MWW.

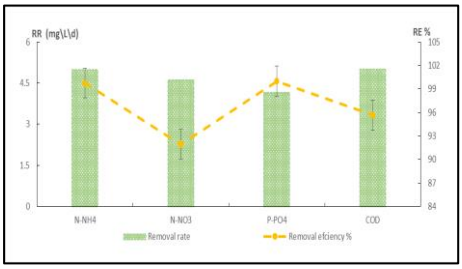


**Figure 1:** Pollutants (N-NH4, N-NO3, P-PO4, and COD) along with their corresponding removal effciency%

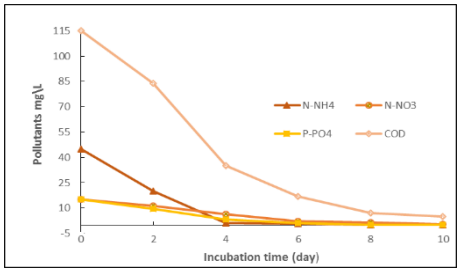


**Figure 2:** Changes in pollutants concentration during the incubation period.

**Table II**. Growth parameters and biomass yield determined for the green microalgae grown in MWW

| Parameters | Values |
|---|---|
| Maximum ell density | 6.06 $10^7$ cell\mL |
| Specific growth rate | 0.550 $day^{-1}$ |
| Doubling time | 1.259 day |
| Biomass concentration | 1.200 mg\L |

## 4 Conclusions

The results of the study suggest that green microalgae exhibit a high growth rate, leading to increased biomass production. Additionally, the study indicates that these microalgae are effective in removing

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pollutants from municipal wastewater (MWW). This finding implies that green microalgae have the potential to be utilized as a sustainable and efficient method for wastewater treatment.

## 5 Acknowledgements

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