

Abstract

Nitrogen oxides (NO_x) aquatic environments pose a significant threat to ecosystem stability. Microalgae are promising candidates for water quality assessment and bioremediation due to their ability to assimilate nitrogen compounds. However, direct experimentation with NO_x gas is limited due to its toxicity and complex regulatory constraints. When NO_x dissolves in water, it generates nitric acid, which serves as a proxy for studying the effects of NO_x contamination. This research investigates the effects of nitric acid, as a dissolved form of NO_x, on the growth of two microalgae species, *Chlorella* sp. AARLG049 and *Desmodesmus* sp. AARLG101, to evaluate their potential for NO_x reduction. The algae were cultivated in media containing nitric acid at concentrations of 0.14, 1.4, and 14 mM for 21 days. Growth dynamics was monitored by measuring absorbance at regular intervals (days 0, 2, 4, 6, 8, 10, 12, 14, and 21) and dry weight on days 0 and 21. The study found that nitric acid concentration significantly influenced algal growth. *Chlorella* sp. AARLG049 exhibited a higher growth rate than *Desmodesmus* sp. AARLG101, particularly from days 8 onward, as evidenced by greater absorbance and dry weight values. At a concentration of 14 mM, both species exhibited significantly reduction in growth, whereas at 0.14 and 1.4 mM, growth remained stable. These findings indicate that nitrogen availability in the form of nitric acid directly affects microalgal growth, with potential implications for water quality management and the development of microalgae-based NO_x mitigation strategies.

Objective

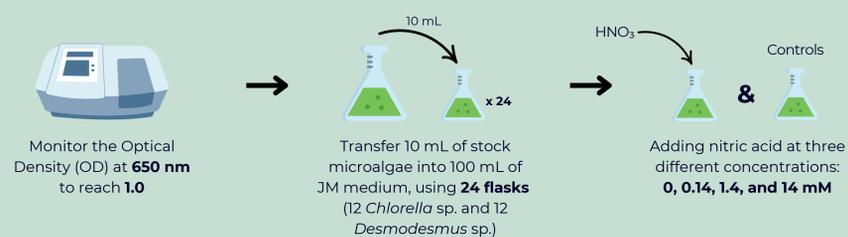
To study the survival rate of microalgae in Nitric Acid-Containing Medium.

Methodology

1. Algal cultivation

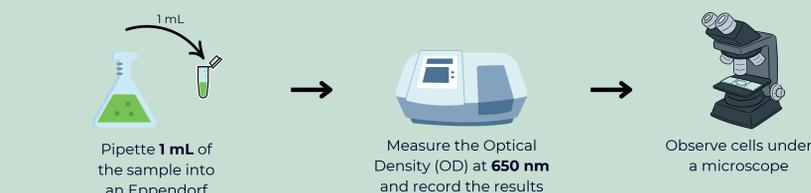


2. Cultivation of microalgae in nitric acid



3. Measurement of microalgae growth

- Optical Density (OD) Day 0, 2, 4, 6, 8, 10, 12, 14 and 21



- Dry weight Day 0 and 21



Results

Optical Density (OD)

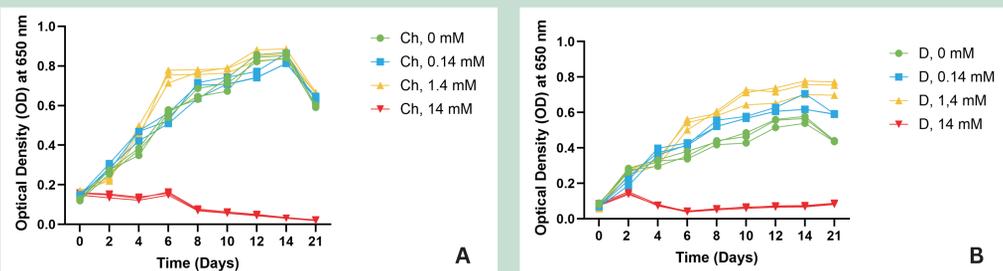


Figure 1 Growth curves obtained from microalgae samples cultured in media with various concentrations of nitric acid : (A) *Chlorella* sp. AARLG049 ; (B) *Desmodesmus* sp. AARLG101.

From figure 1, when looking at the trend from the graph, it can be seen that algae can grow at a nitric acid concentration of 1.4 mM, with the lowest growth observed at 14 mM.

Results

Dry weight

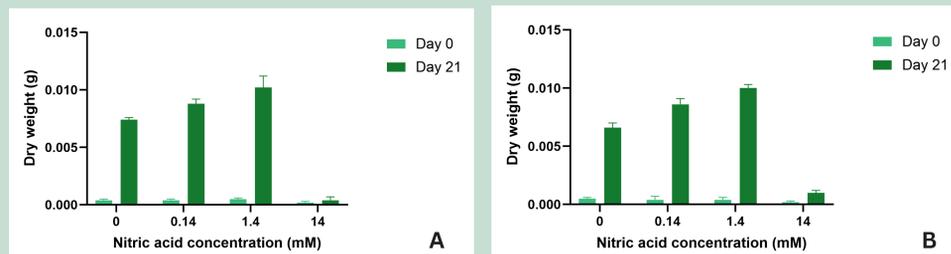


Figure 2 Bar graphs comparing the dry weight of microalgae cultured in media with various concentrations of nitric acid : (A) *Chlorella* sp. AARLG049 ; (B) *Desmodesmus* sp. AARLG101.

From figure 2, when looking at the graph, it can be seen that algae can grow at a nitric acid concentration of 1.4 mM, with the lowest growth observed at 14 mM.

Chlorophyll a

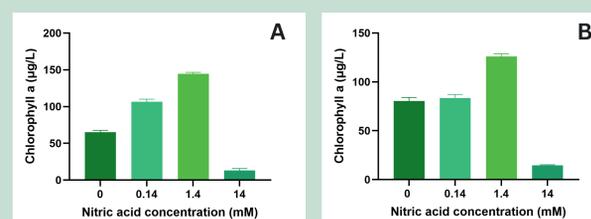


Figure 3 The graph shows the amount of chlorophyll a in microalgae cultured in media with various concentrations of nitric acid on day 21 : (A) *Chlorella* sp. AARLG049 ; (B) *Desmodesmus* sp. AARLG101.

From figure 3, when looking at the graph, it can be seen that the algae have the highest amount of chlorophyll a at a nitric acid concentration of 1.4 mM, and the lowest at a concentration of 14 mM.

Morphology

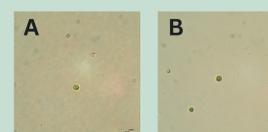


Figure 4 *Chlorella* sp. AARLG049 at a nitric acid concentration of 0 mM ; (A) Day 0 and (B) Day 21

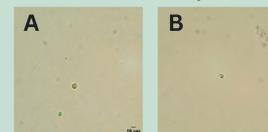


Figure 5 *Chlorella* sp. AARLG049 at a nitric acid concentration of 0.14 mM ; (A) Day 0 and (B) Day 21

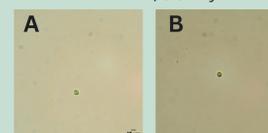


Figure 6 *Chlorella* sp. AARLG049 at a nitric acid concentration of 1.4 mM ; (A) Day 0 and (B) Day 21



Figure 7 *Chlorella* sp. AARLG049 at a nitric acid concentration of 14 mM ; (A) Day 0 and (B) Day 21

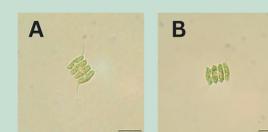


Figure 8 *Desmodesmus* sp. AARLG101 at a nitric acid concentration of 0 mM ; (A) Day 0 and (B) Day 21

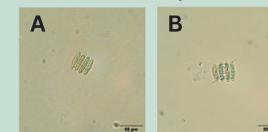


Figure 9 *Desmodesmus* sp. AARLG101 at a nitric acid concentration of 0.14 mM ; (A) Day 0 and (B) Day 21

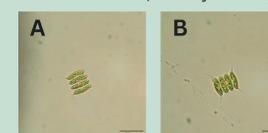


Figure 10 *Desmodesmus* sp. AARLG101 at a nitric acid concentration of 1.4 mM ; (A) Day 0 and (B) Day 21



Figure 11 *Desmodesmus* sp. AARLG101 at a nitric acid concentration of 14 mM ; (A) Day 0 and (B) Day 21

From figures 4, 6, 7, 8, 10, and 11, it can be seen that there is no change in the algae cells. However, from figures 5 and 9, it can be observed that the algae cells appear pale at a nitric acid concentration of 14 mM.

Conclusion

The optimal nitric acid concentration for microalgal survival was 1.4 mM, while higher concentrations inhibited growth.

References

- Xin, L., Hong-Ying, H., Ke, G., & Ying-Xue, S. (2010). Effects of different nitrogen and phosphorus concentrations on the growth and lipid accumulation of a freshwater microalga *Scenedesmus* sp. *Bioresource Technology*, 101(14), 5494-5500. <https://doi.org/10.1016/j.biortech.2010.02.016>
- Wang, H., Fu, R., Pei, H., Jiang, L., & Hu, W. (2013). Effects of nitrogen concentration on growth and lipid accumulation of *Chlorella* sp. in wastewater. *Applied Biochemistry and Biotechnology*, 171(8), 2396-2406. <https://doi.org/10.1007/s12010-013-0488-3>