May 1st, 12:00 AM

Effects of Light Intensity on the Oxygen Production of Spirulina

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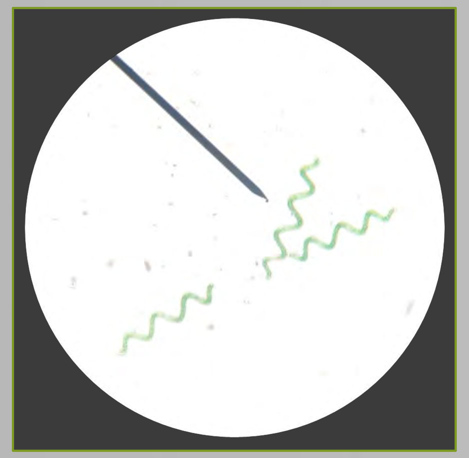
Background Information

Space travel is challenging due to the depletion of resources as missions become lengthier. The cyanobacteria, *Arthrospira platensis,* has the potential to resolve this problem. *Spirulina* is an excellent source of protein, vitamins, and minerals. It is also a photosynthetic organism, so it converts light energy into the chemical energy it needs to survive. Through this process, carbon dioxide is absorbed, and oxygen is released as a byproduct. *Spirulina* could not only be used as a food source due to its high protein and vitamin content but as a way to consume carbon dioxide and produce oxygen due to its photosynthetic nature.

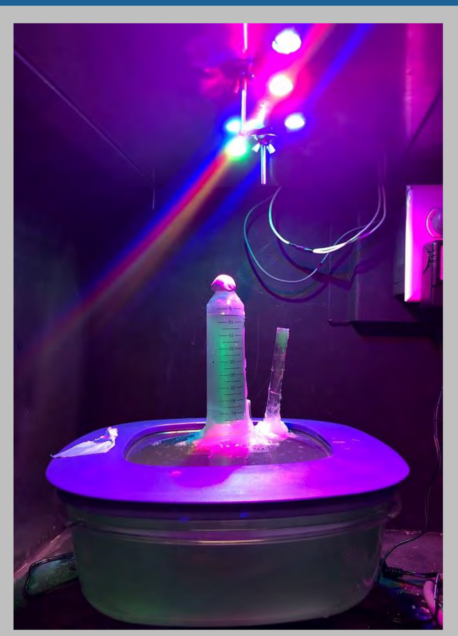


Goals

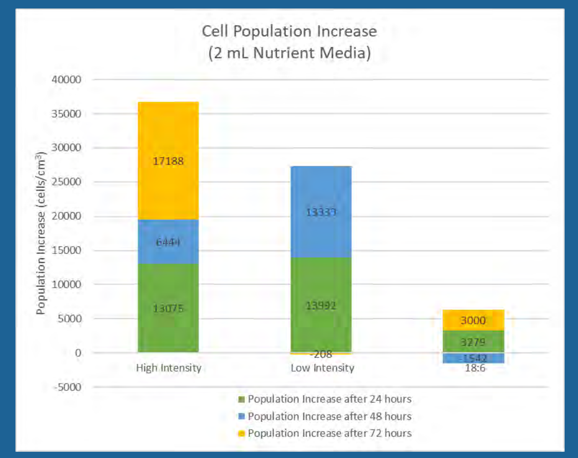
- To determine the effects of light intensity on the evolution of oxygen from *Spirulina* and on cell growth
- To determine the effects of nutrient availability on the evolution of oxygen from *Spirulina* and on cell growth

Methods

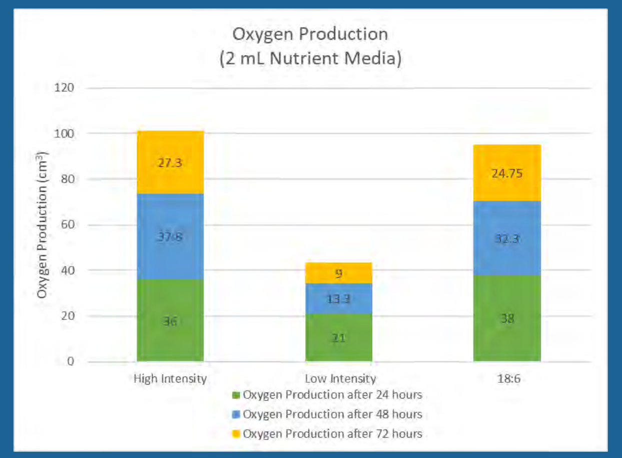
- *Spirulina* cultures were maintained in alkaline conditions with a pH of 10 at 28 ℃ with 60 mL of Zarrouk's media given daily.
- Airtight containers were filled with 2.9 L *Spirulina* culture in solution and grown in white light boxes with different light intensities (10 μmol m^{-2} s^{-1} and 18 μmol m^{-2} s^{-1}).
- A third container was placed in 15 μmol m^{-2} s^{-1} white light, receiving 18 hours of light per 24 hour period.
- Each experiment was allowed to run for 72 hours.
- For experiment 1, cell count and amount of oxygen produced were collected every 24 hours, and 2 mL of nutrient media was given to each culture.
- For experiment 2, cell count and amount of oxygen produced were collected every 24 hours, and 6 mL of nutrient media was added to each container every 24 hours.



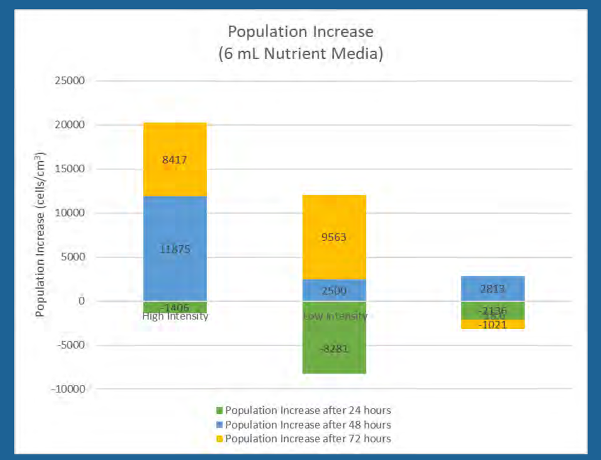
Results



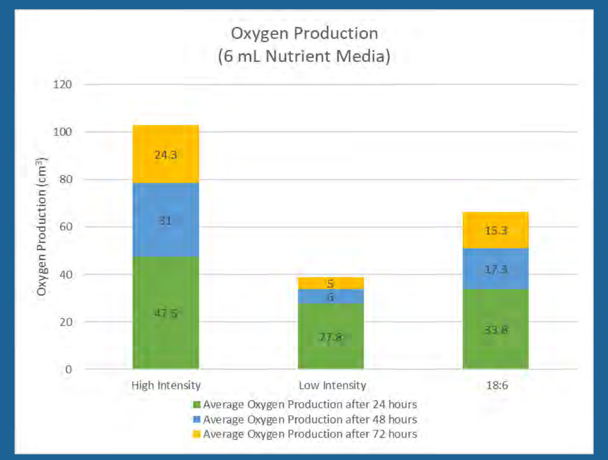
The graph shows that a higher intensity light resulted in a greater population increase over 72 hours (36,707 cells/cm^3) than a lower intensity light or a light-dark cycle, which resulted in 26 % less population increase (27,117 cells/cm^3) and 87% less population increase (4,737 cells/cm^3) respectively.



This graph shows that higher light intensity produced more oxygen per 72 hours (101.1 cm^3) than a lower intensity light or a light-dark cycle, which produced 58 % less oxygen (43.3 cm^3) and 6% less oxygen (95.05 cm^3) respectively.



The graph shows that increasing the availability of nutrients results in an 51 % decrease in cell population (18,286 cells/cm^3) in high intensity light over 72 hours, an 86 % decrease (3,782 cells/cm^3) in low intensity light over 72 hours, and an 107% decrease (-334 cells/cm^3) in a light-dark cycle over 72 hours.



The graph shows that tripling the amount of nutrients resulted in 1.7% more oxygen (102.8 cm^3) in high intensity light, 10 % more oxygen (38.8 cm^3) in low intensity light, and 30% less oxygen in a light-dark cycle.

Discussion/Conclusions

The results show that oxygen production and population increase is greatest at a high light intensity. This is due to a higher rate of photosynthesis in the presence of more light energy. Increasing the availability of nutrients did not result in a change in oxygen production in high or low intensity light. Increasing nutrient availability resulted in a cell population decrease in high intensity light, low intensity light, and a light-dark cycle.

Acknowledgements

BIOLOGY OUACHITA BAPTIST UNIVERSITY
Arkansas Space Grant Consortium
ARKANSAS INBRE IDeA Networks of Biomedical Research Excellence