Testing Effectiveness of Aqueous Phases from Struvite and Hydroxyapatite Mineral Precipitation as Algal Nutrient Sources

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Presented at: 2017 Virginias Collegiate Honors Council Spring Honors Conference
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ABSTRACT

As interest in algal biofuel grows, the need to explore diverse nutrient sources for growing algae becomes apparent. Struvite and hydroxyapatite (HAP) were precipitated after flash hydrolysis. The leftover aqueous phase (AP) could serve as a nutrients source for algae cultivation and the potential reuse of this waste stream is promising. To test this, 12 bottles of *Scenedesmus sp.* Algae*:* four of struvite, four of HAP, and four control AM-14 synthetic media were cultivated. 10% of the phosphorus in the synthetic media was replaced with phosphorous from the struvite AP, and 10% of the nitrogen in the synthetic media was replaced with HAP AP. The bottles with struvite AP replacement experienced higher algae growth compared to the control and HAP AP which experienced very slow growth. Based on the results, struvite AP appears to be a viable nutrient replacement for algae cultivation while HAP AP toxicity should be further investigated.

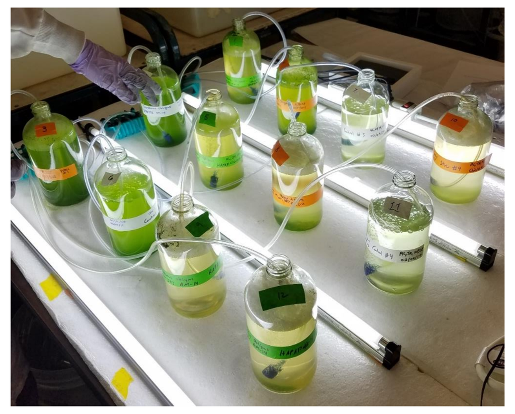
BACKGROUND

As the demand for power and fuel continue to rise, further energy options must be examined. Algae is one such resource that must be further looked into. Algae can be refined into biofuels that would not only be easy to grow, but would harm the environment far less than the current fossil fuel method. Algae is currently not on the market due the cost of production. Currently, the refinement process is very inefficient requiring large amounts of algae to obtain small amounts of biofuel. One way to lower the costs to grow the algae would be to recycle nutrients from the refinement process. This would allow algae to be grow more economically and therefore make up for the inefficient refinement process.

During the refinement process, the oils and proteins are extracted from the algae. Two byproducts of this process are struvite and hydroxyapatite. Struvite is known to be an effective fertilizer, commonly sold as a byproduct of wastewater treatment. Hydroxyapatite is commonly found in the bones and teeth of animals. If these compounds will allow and enable algae growth, then this would prove Nutrient Recycling as feasible for algae that would dramatically lower the cost of algae production

Measurements Performed:

- Algae Cell Count
- Light Reading (Measured in Lux)
- pH Reading (Taken at 11:00 A.M. daily)
- Temperature (Measured in Degree Celsius)
- Total Suspended Solids (50 mL sample)



Above: Laboratory Setup Day 7

COMPOSITION

Control Sample Contains:

- 100 mL of *Scenedesmus* Algae Culture
- 16 mL of Part A, which consists of $NaNO_3$
- 16 mL of Part B, which consists of K_3PO_4
- 8 mL of Part C, which consists of NaCl, $CaCl_2$, and $MgSO_4$*$7H_2O$
- 0.8 mL of Part D, which consists of Na_2EDTA, $FeCl_3$, and H_3BO_3

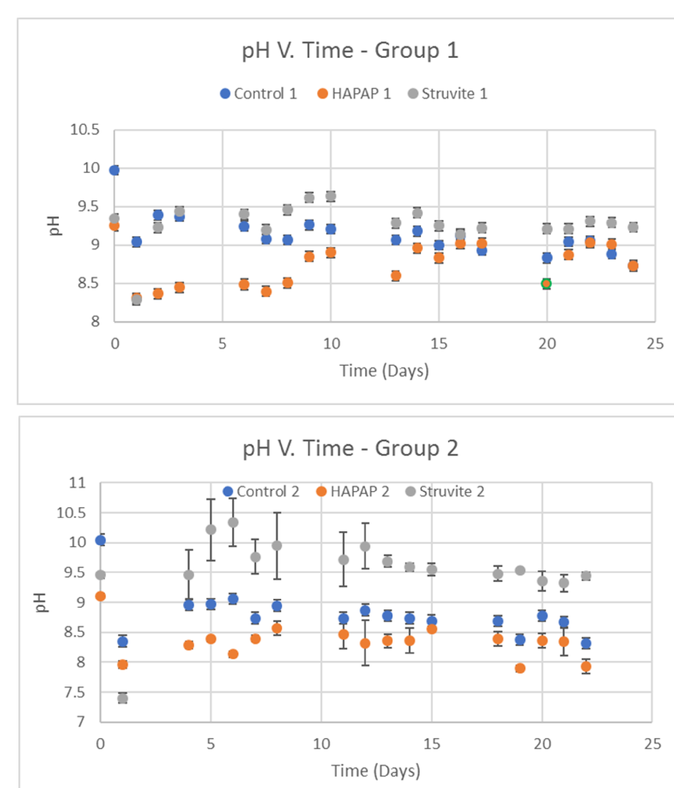
Hydroxyapatite Aqueous Phase Sample Contains:

- 100 mL of Scenedesmus Algae Culture
- 14.4 mL of Part A
- 16 mL of Part B
- 8 mL of Part C
- 0.8 mL of Part D
- 15 mL of hydroxyapatite A.P. $[Ca_{10}(PO_4)_6(OH)_2]$

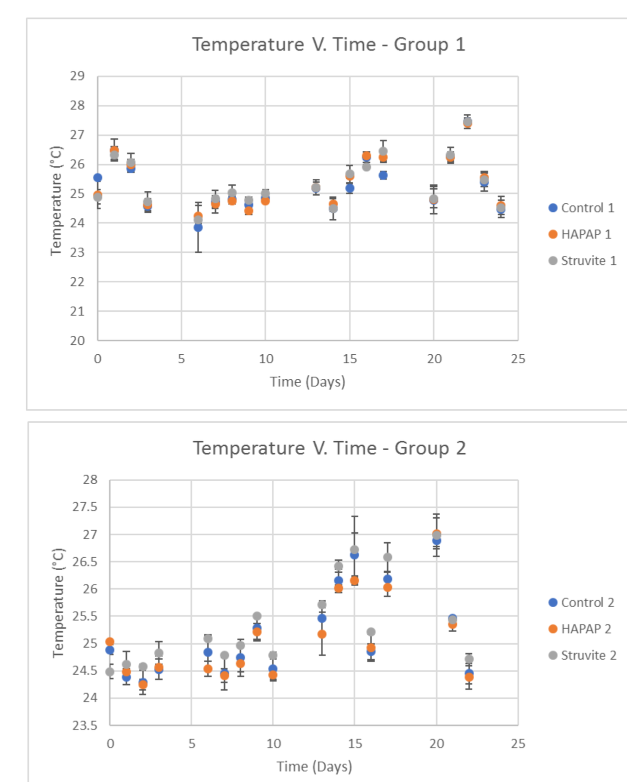
Struvite Aqueous Phase Sample Contains:

- 100 mL of Scenedesmus Algae Culture
- 13.9 mL of Part A
- 14.4 mL of Part B
- 8 mL of Part C
- 0.8 mL of Part D
- 113 mL of struvite A.P. $[NH_4MgPO_4{\cdot}6H_2O]$

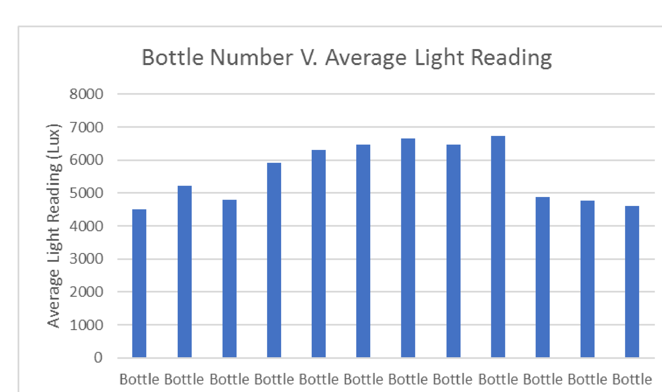
RESULTS



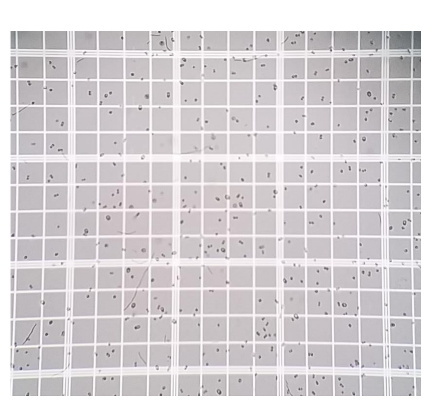
Above: pH versus Time Graphs



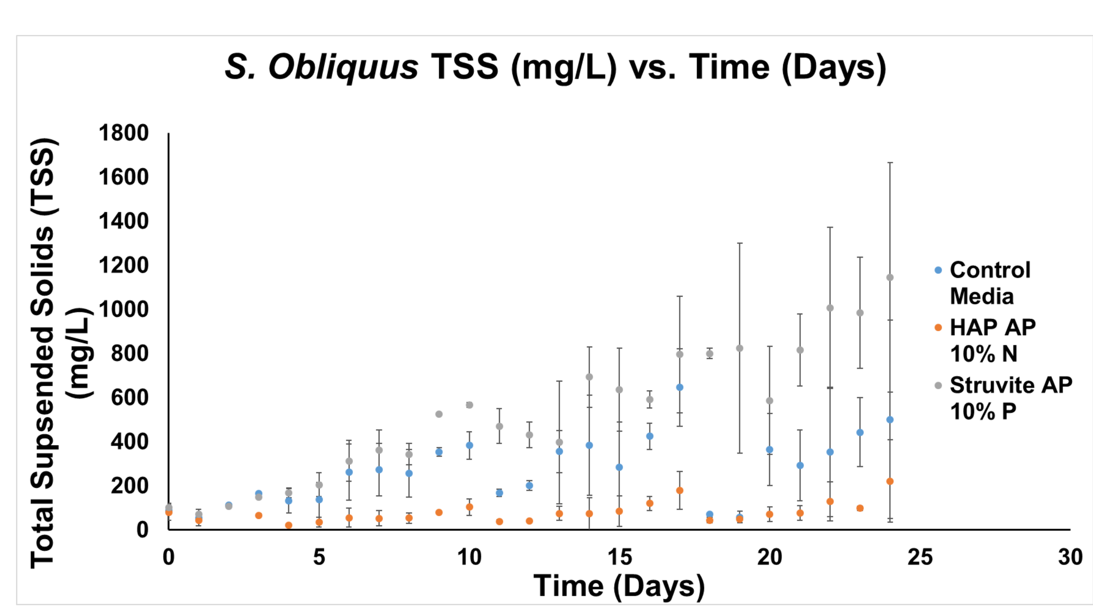
Above: Temperature versus Time Graphs



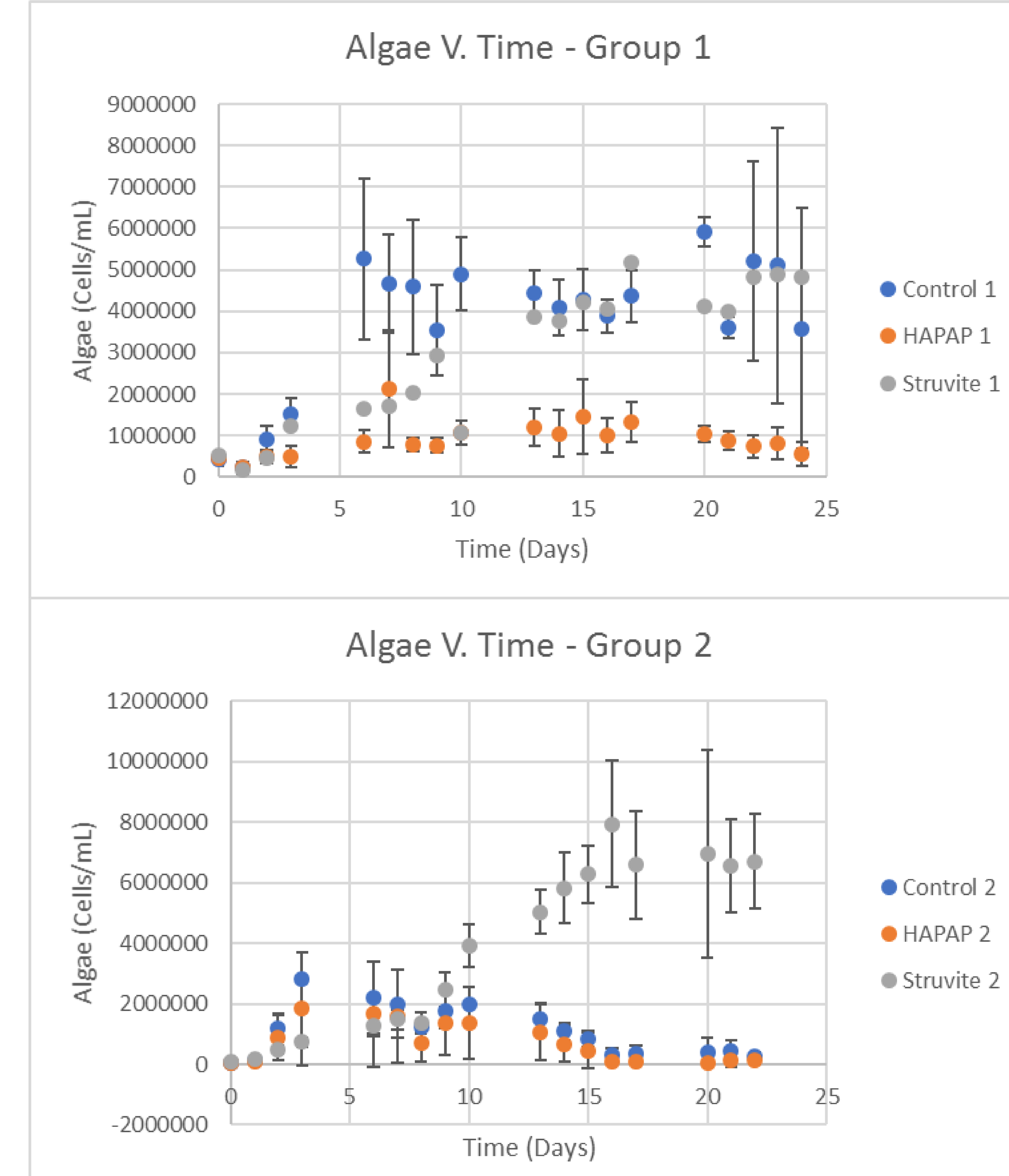
Above: Average Light Reading per Bottle



Above: Algae Counting Example



Above: TSS versus Time Graph



Above: Algae versus Time Graphs

CONCLUSIONS

- Based off the Algae versus Time Graphs, we can conclude that the hydroxyapatite aqueous phase (HAPAP) slowed the algal growth compared to the struvite and Control samples.
- Furthermore, we can conclude that the struvite aqueous phase performed as well, if not better, that the control sample with growing algae.

REFERENCES

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ACKNOWLEDGMENTS

- NSF CAREER Award #CBET-1351413 (2013-18)
- NSF SEP # 1230961 (2012-15) and 1631953 (2015-17))