The Effects of Chemical Compounds on Algae Growth and Survival

[redacted]

I. Introduction

Plants are the most important food source to all life on earth because all energy can be traced back to a plant. A hamburger can trace its chemical energy back to the cow that ate the grass, and this grass got its energy from photosynthesis. The same can be said about a paramecium because it got its energy from eating algae. These plants are essential for life, so as a race, humans should learn everything they can about the resources on which they depend. Important factors to learn to about plants like algae would be how they grow and survive. Because of all the important reasons, it should be asked, what are the effects of nitrogen, chlorine, and iodine compounds on algae growth and survival?

II. Review of Literature

A. Green Algae

Algae is a microscopic plant that lives in bodies of water. Green algae cells can live independent, but algae cells will live in colonies with other green algae organisms. “Colonies are circular, star-like shapes, usually made up of eight, sixteen, or thirty-two individual Pediastrum boryanum [green algae]. Smaller colonies with two or four Pediastrum boryanum don't stay that way long, because they grow fast.” (Painter 2013). As stated before algae reproduces quickly, and it does this mostly through asexual reproduction.

> Some reproduce asexually, others use sexual reproduction, and many use both. In asexual reproduction an individual reproduces without combining its genetic material with that from another individual. The simplest form of asexual reproduction is binary fission, in which a unicellular organism simply divides into

two new individuals. Some multicellular algae, including Sargassum, reproduce asexually through fragmentation, in which fragments of the parent develop into new individuals. *Steinman 2000*

Based on the information stated it can be assumed that algae will reproduce quickly and gain mass within a week's time. Since algae is a plant it preforms photosynthesis. This process is the way that plants create oxygen and sugar for themselves from water, carbon dioxide, and sunlight. Algae is a critical part of the pond ecosystem because they produce these sugars and oxygen. Other organisms rely on the algae plant for food and oxygen. Algae is not all good for the environment though. Some species can release toxins that harm-human made structures. "Some [algal] species have the potential to produce toxins… Due to the toxins they produce blue-green algae can affect water consumers in a number of ways. They have been associated with nausea, headache, vomiting, abdominal pain, diarrhea, gastroenteritis, muscle weakness, pneumonia and paralysis."(Jones 2006). In conclusion, algae is a simple life-form living in ponds that reproduces quickly and is vital to its ecosystem's food chain, but it can also be a harmful organism if it releases toxins.

B. Nitrogen Compounds

Nitrogen compounds are used every day for fertilizer. The nitrogen atom is used in many processes the plant goes through, like photosynthesis. Biologically, nitrogen is used for protein in amino acids, base pairs of DNA and RNA, prosthetic groups for protein, hormones, metal uptake, and chemical defenses (Barak 1999). It is easy to see how essential nitrogen is to plant life. Algae absorbs its nitrogen from other animals through their waste, however nitrogen could also be absorbed by algae if it was in a

solution with water. In conclusion, algae and all other plant life on earth need nitrogen to live. They use it in photosynthesis, proteins, and essential hormones.

C. Chlorine Compounds

The uses of Chlorine are completely different from those of nitrogen in relationship to microbes. “Chlorine inactivates all types of microorganisms: protozoa, bacteria and viruses. The rate of inactivation varies widely, but is more rapid when more chlorine is present in the water” (World Health Organization). Chlorine is often used in a solid tablet form to cleanse pools or other bodies of water that someone would want to be free of microbes. With most chemical compounds, the reactions occur and then their impacts are not long lasting. With chlorine, however, the effect stays in the water for a period of time. “An important advantage of chlorine as a disinfectant is that it remains in the water and continues to protect against the effects of re-contamination” (World Health Organization). In conclusion, chlorine is very effective at inactivating microbes and keeping the microbes away.

D. Iodine Compounds

Iodine is another chemical proven to inactivate microbes. It is different than chlorine tablets because it is not used in solid form. Iodine is used in a solution as a liquid. Iodine forms an acid when it comes into contact with water. The acid is hypoiodous acid (HOI) and this is what kills the microbes. In general, iodine is most effective against bacteria and viruses, but iodine is weak against cysts. (Clarke 2006). While both chlorine and iodine are proven to be successful at removing microbes, iodine is proven to be more effective. Unfortunately, iodine is not the best choice for all people because some may have an iodine allergy (Curtis 1998). In conclusion, iodine solutions are another useful method to clean water, and iodine solutions are proven to be better than chlorine tablets.

III. Hypothesis

Based on the information given, if nitrogen compounds are introduced into water with green algae in it, then the algae will survive and grow because nitrogen is important to plant growth. There will be more algae in the nitrogen cup by the end of the week. Conversely, if chlorine or iodine compounds are introduced into water with green algae in it, then the algae will not survive and the growth will decrease because chlorine and iodine are proven to inactivate growth in microbes. Also, chlorine will not deactivate the microbes as well as iodine, so there will be more algae in the chlorine cup than in the iodine cup.

IV. Methods/ Procedure

A. Materials

1. 1 gram of chlorine dissolvable tablets
2. 1 gram of iodine drops
3. 1 gram of nitrogen pellets from fertilizer
4. 4 plastic cups
5. 20 grams of algae
6. 40 ml of distilled water
7. An incandescent lamp for lighting
8. A tool for measuring volume
9. A scale
10. A sheet of paper to record results
11. A camera for photos
12. Gloves for handling the algae

B. Procedure

1. Place 10 ml of distilled water into each of the plastic cups.
2. Place 5 grams of algae into each of the cups.
3. Take a picture of the algae for record.
4. Place 1 gram of nitrogen into one of the cups, repeat this step for chlorine and iodine. Leave the one cup empty for the control.
6. Record the state of the algae, and take a picture of the algae.

7. Wait one week for the algae to grow.

8. After the week record the mass of the algae.

V. Results

A. Pictures

Algae before treatment

Control algae after procedure

Iodine algae after procedure (discoloration due to treatment)

Chlorine algae after procedure

Nitrogen algae after procedure

B. Mass of Algae

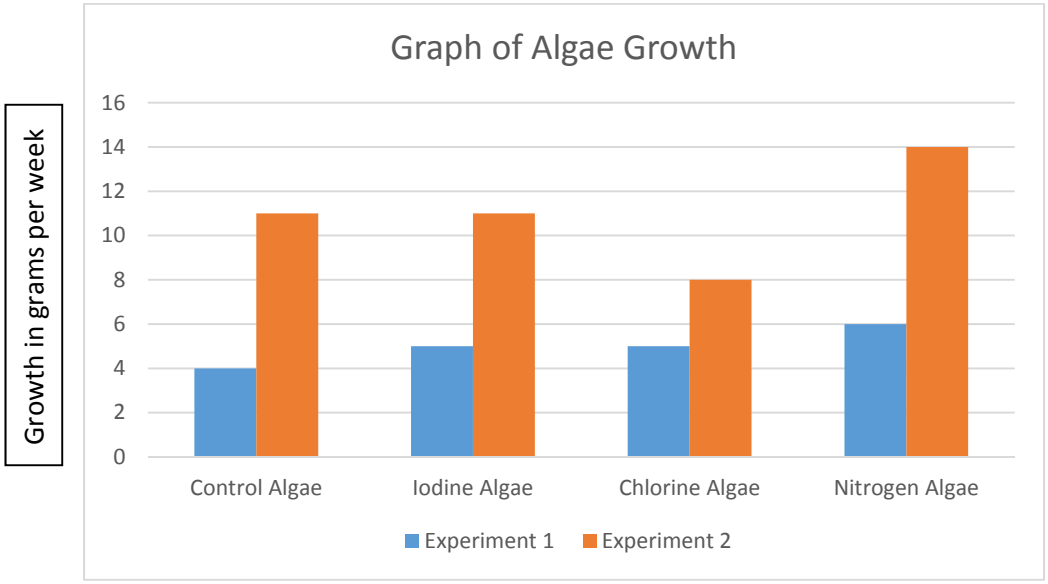
1. Table One- data from first experiment (growth in grams per week)

Control algae	Iodine algae	Chlorine algae	Nitrogen algae
4	5	5	6

2. Table Two- data from second experiment (growth in grams per week)

Control algae	Iodine algae	Chlorine algae	Nitrogen algae
11	11	8	14

3. Graph of Algae Growth



VI. Discussion

The results of the experiments tend to show a pattern. All algae grew no matter what treatment was applied. It can be concluded that algae can fight back treatments when the treatment is not applied daily. Also, Algal growth affected by nitrogen was significantly higher than all other test subject growth, and according to the second experiment, algal growth affected by chlorine and iodine is either at or below the control's growth. Based on the results and previous research it can be concluded that nitrogen compounds have a positive effect on the growth rate of algae. However, the chlorine and iodine data is inconclusive due to the variation relative to the control. In experiment one, the iodine and chlorine algae had a greater mass after one week than the control, but in experiment two, the data shows that iodine growth was equal to the control's growth, and the chlorine's growth was less than the control. Due to these differences, the results seem inconclusive.

There could be a reason why the results were so different in the experiments. In experiment one, the algae was immediately placed in water with the variable. This meant that the dry algae soaked up water, and thus the results were affected by the swelling. What was actually measured in experiment one was how much the algae grew plus how much water the algae absorbed. In experiment two, this problem was corrected. All algae was able to first soak up water before the treatment was applied, allowing for more concise and reasonable results.

There is another curious result, along with the variation from experiment one and experiment two. Iodine's rate of growth should have been less than that of the control's rate of growth according to the previous research. This is an explainable event. During the experiment there was no disinfecting spray sprayed over the algae because the chemicals in the spray could have affected the growth of the algae, however, due to the fact that the area was not sterile, mold grew on the algae in experiment two, specifically the iodine algae. Therefore, when the mass of the algae was taken, the mass of the mold added to the overall mass. This tainted the results and therefore the iodine's mass is inconclusive, but it can still be assumed that the iodine's mass would've been less than the control's mass since mold didn't grow as much on the control.

Obviously, for more conclusive data, more experiments need to be completed. If one was going to attempt this experiment, then they should learn from the mistakes made in this experiment and put the algae in a sterile room and make sure the algae is cultured before the treatment is applied. These changes would make the experiment more legitimate and can prove without a doubt the effects of these chemicals on algal growth.

VII. Conclusion

In conclusion, the results of the nitrogen affected algae proved the hypothesis to be correct. Without a doubt nitrogen compounds affect algae growth in a positive manner. Also the algae affected by chlorine proved the hypothesis to be correct. The growth of the chlorinated algae was less than that of the control. The iodine data was not conclusive due to the fact that the mold was growing on the algae; therefore the hypothesis' statement saying that iodine algae would grow less could not be proven or disproven. The most important lesson this experiment teaches is that algae and microbes do not just die off after one treatment. In order to keep water clean and safe for drinking, it must be treated constantly and effectively because algae is resilient.

References

Barak, P. (1999, January 5). Nitrogen. *Nitrogen*. Retrieved November 25, 2013, from http://soils.wisc.edu/facstaff/barak/soilscience326/nitrogen.htm

Chlorination concepts. (n.d.). *Fact Sheets on Environmental Sanitation,* 117-122. Retrieved November 26, 2013, from http://www.who.int/water_sanitation_health/hygiene/emergencies/fs2_17.pdf

Clarke, S. H. (2006). Iodine disinfection in the use of individual water purification devices. *Technical Information Paper,* 1-10. Retrieved November 25, 2013, from http://phc.amedd.army.mil/PHC%20Resource%20Library/Iodine%20Disinfection%20in%20the%20Use%20of%20Individual%20Water%20Purification%20Devices.pdf

Curtis, R. (1998, March). OA Guide to Water Purification. *OA Guide to Water Purification*. Retrieved November 21, 2013, from http://www.princeton.edu/~oa/manual/water.shtml

Jones, G. (2006). Blue-green algae-- general information. *Natural Resources and Water,* 1-4. Retrieved November 26, 2013, from http://www.nrm.qld.gov.au/factsheets/pdf/water/w3.pdf

Painter, T. (n.d.). Green algae. *Green Algae*. Retrieved from http://www.fcps.edu/islandcreekes/ecology/green_algae.htm

Steinman, A. D., Ph.D. (2000). Algae. *Algae*. Retrieved November 21, 2013, from http://autocww.colorado.edu/~blackmon/E64ContentFiles/AlgaeAndFungi/Algae.html