LIFE IN THE WATERS OF EAST RIVER: EFFECTS OF SALINITY AND DISSOLVED OXYGEN ON CELLS

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Abstract

Aquatic environments differ in their chemical composition, which, in turn, affects the organisms living in the water. Among the dissolved materials that affect the chemistry of water and as a consequence, the aquatic organisms, are salinity and the dissolved oxygen (DO) and carbon dioxide. Here we present the results of our research into the salinity of a surface-water sample from East River and the effect of different salinity on vacuoles of cells normally adapted to fresh water. We also determined the amount of DO in our water samples, and studied the anaerobic process of cell respiration. Finally, we determined the presence of coliform bacteria by inoculating media which specifically allows coliform bacteria growth. We developed experiments and questions to determine the properties of our water sample taken from East River, and developed tables and graphs that allowed us to analyze our results.

Introduction

Aquatic life is affected by three important factors, salinity, dissolved oxygen and dissolved carbon dioxide. In order to measure the effects caused by these factors we conducted experiments using water samples from the East River. Our water sample came from a specific area of the East River called Long Island City Deep. The sample was collected on 9/27/18 at 6:35am and had a temperature of 23 °C. In detail Dissolved oxygen (DO) is oxygen that is dissolved in the water through air or released in the water from aquatic plants as a byproduct from photosynthesis. DO is essential for many marine organisms because it is necessary for their survival. For example, some fishes use their gills to extract dissolved oxygen into the blood and travels to the cell for cellular respiration. Also, single celled bacteria such as fungi depend on DO because they use up the remaining oxygen in the water to break down the plants and release nutrients in the water. Without the presence of dissolved oxygen bacteria can no longer be fed through these plants and will eventually die off. Carbon dioxide (CO_2) is another gas that is dissolved in the water. Plants and animals like coral reefs and crustaceans that live in the water depend on CO_2 to carry out photosynthesis and for growth. However, according to The Ocean Portal Team (2018) stated that an increase of dissolved CO_2 in water increase the acidity which results in a decrease amount of calcium carbonate. Marine organisms build their skeleton or shell using calcium carbonate. (para. 13) Another source that influences organisms is Salinity. Salinity is the amount of dissolved salt in a body of water. The salinity in brackish water ranges from 0.5 to 35 ppt. (National Oceanic and Atmospheric Administration, 2004). Animals and Plants are affected differently by the type of solution they are placed in. Animal cells placed in isotonic solutions stay constant whereas plant cells become flaccid. Certain conditions that would affect the salinity in oceans is precipitation, evaporation and winds. These conditions would decrease the overall salt concentration because it would involve an increase of freshwater. This would have an impact on marine life because different organisms require different levels of salinity in order to live. It is important to have a background of the dissolved materials in water to observe its influence of organisms because they are essential and a key element in life.

Materials and Methods

Our water sample, Long Island City Deep, was tested for dissolved O2, dissolved CO2, and salinity. Our instructor took the pH and temperature at the time of collection. Salinity was measured using the evaporation method. Also, our water sample and NaCl was used to determine the percentage of change in mass through a standard curve graph. Dissolved Oxygen was measured with a LaMotte oxygen titration kit. We had to add two chemical reagents which will fix the oxygen present in our water sample. This will allow us to titrate the amount of dissolved oxygen in our water. Dissolved Carbon Dioxide was measured using the LaMotte Titration kit. We add two drops of Phenolphthalein Indicator and filling the direct reading titrator with Carbon Dioxide Reagent and inserting into the test tube. Also, with the use of our water sample and bicarbonate concentrations to determine the rate of photosynthesis. Lastly, we determine if our water was a hypotonic or hypertonic by using our microscope. We observe and measure the vacuoles placed in each solution as well in our water sample.

Results

The standard curve and mass change from different NaCl concentration

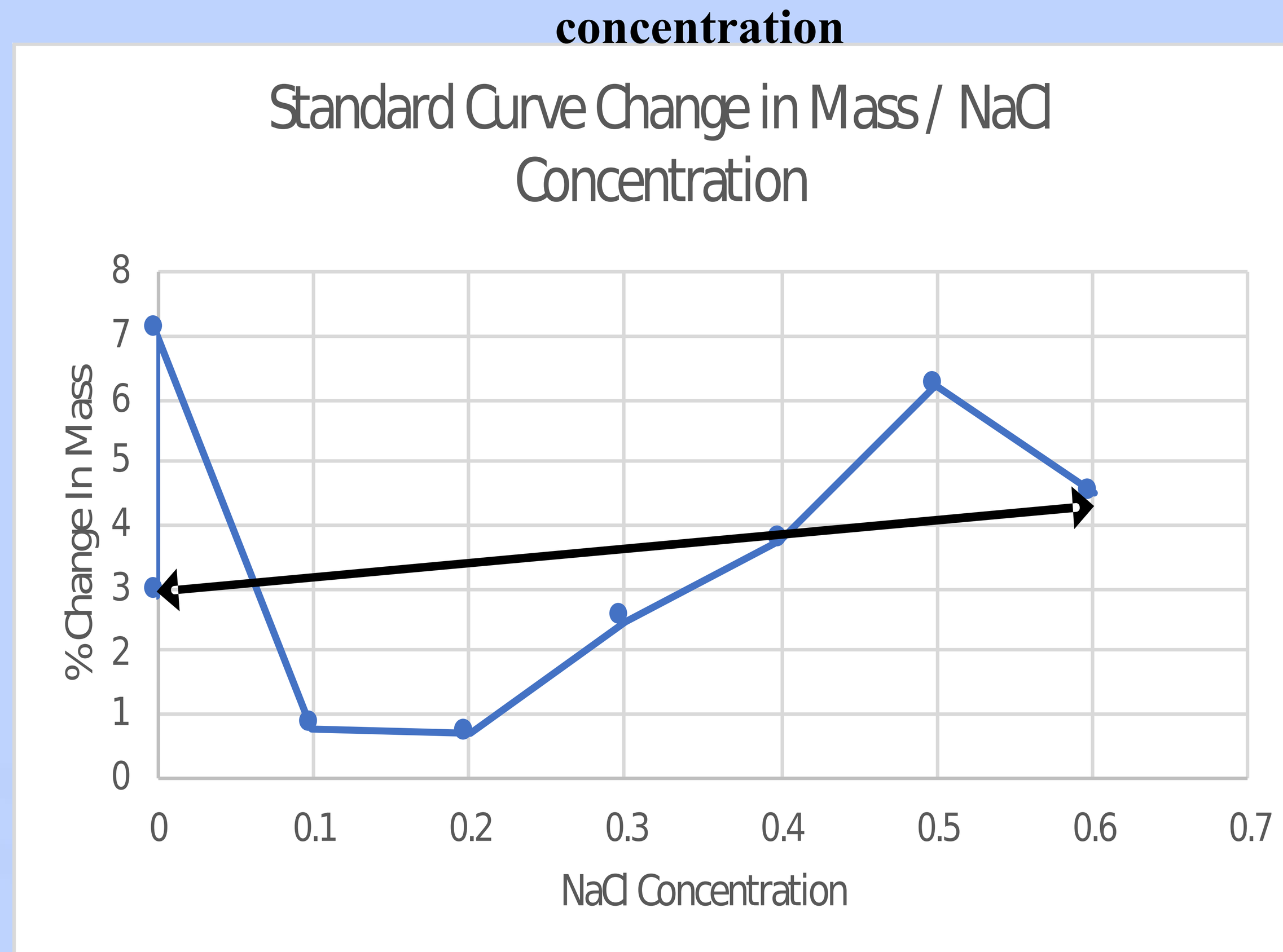

Figure 1. The graph above illustrates the final percent change in mass.

Change in Mass / NaCI Concentration

M	%Change
0	2.89
0	7.04
0.1	0.78
0.2	0.68
0.3	2.48
0.4	3.74
0.5	6.2
0.6	4.49

Figure 2. The table depicts the change of mass in percentage of each NaCI solutions that has change within time.

Length of onion cell vacuoles in different solutions

Measurements	Length vacuoles hypotonic solution	Length vacuoles hypertonic solution	Length vacuoles water sample
1	108 µm	250 µm	350 µm
2	100 µm	160 µm	107 µm
3	306 µm	300 µm	208 µm
4	207 µm	220 µm	102 µm
5	304 µm	310 µm	200 µm
Average	205µm	248 µm	193.4 µm

Figure 3. This table shows the measurements of onion cell vacuoles placed in tonicity solutions.

Pictures of Onion Cells Vacuoles in Tonicity Solutions

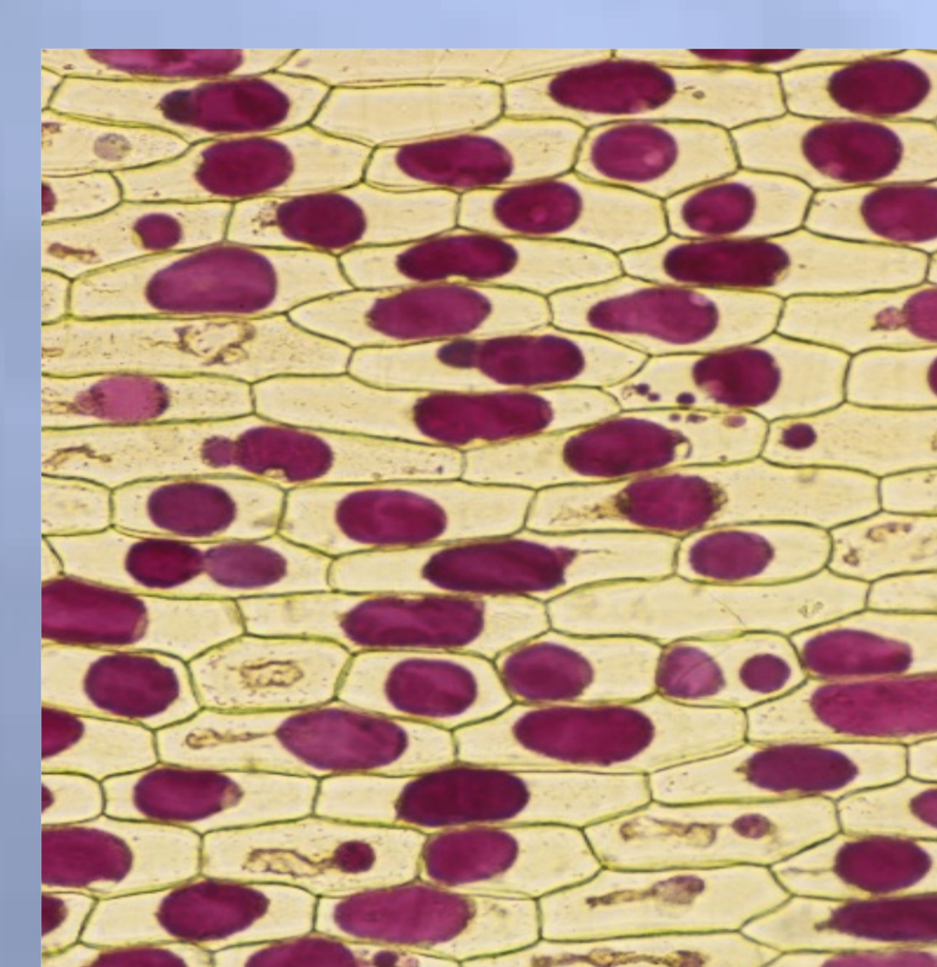

Figure A: Onion cell vacuoles in hypertonic solution

Figure B: Onion cell vacuoles in isotonic solution

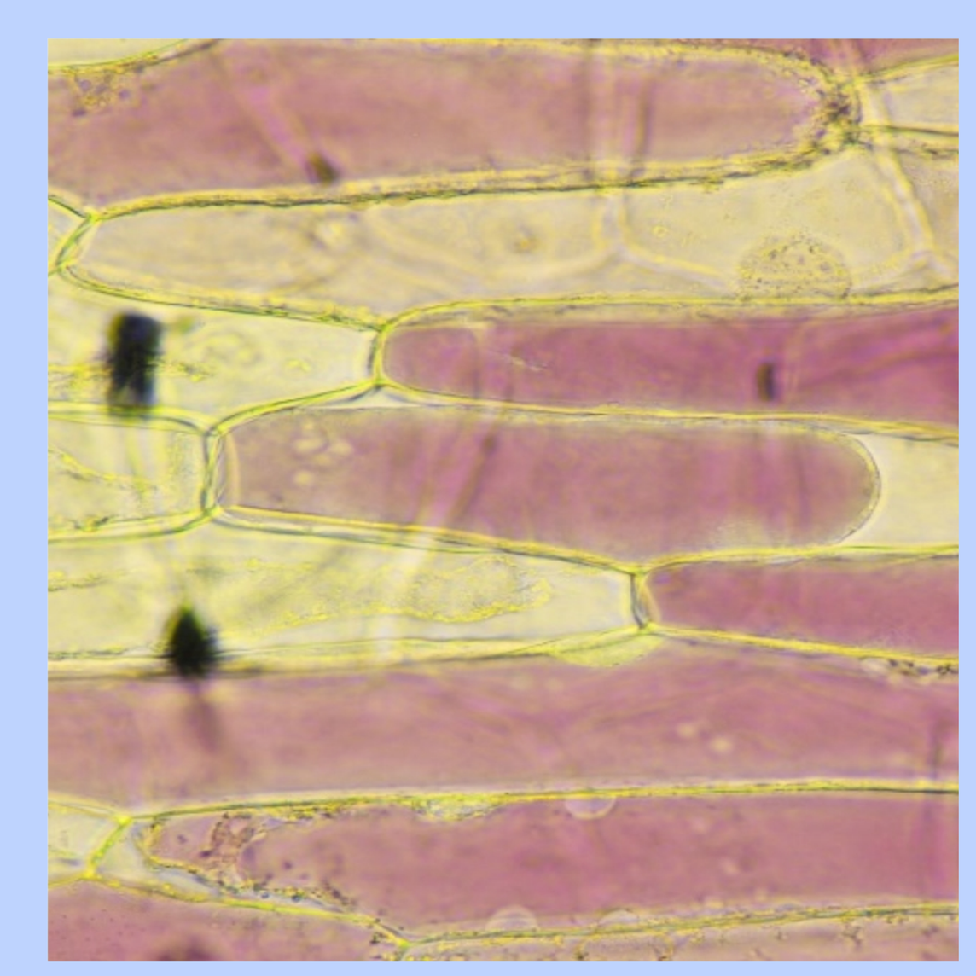

Figure C: Onion cell vacuoles placed in hypotonic solution

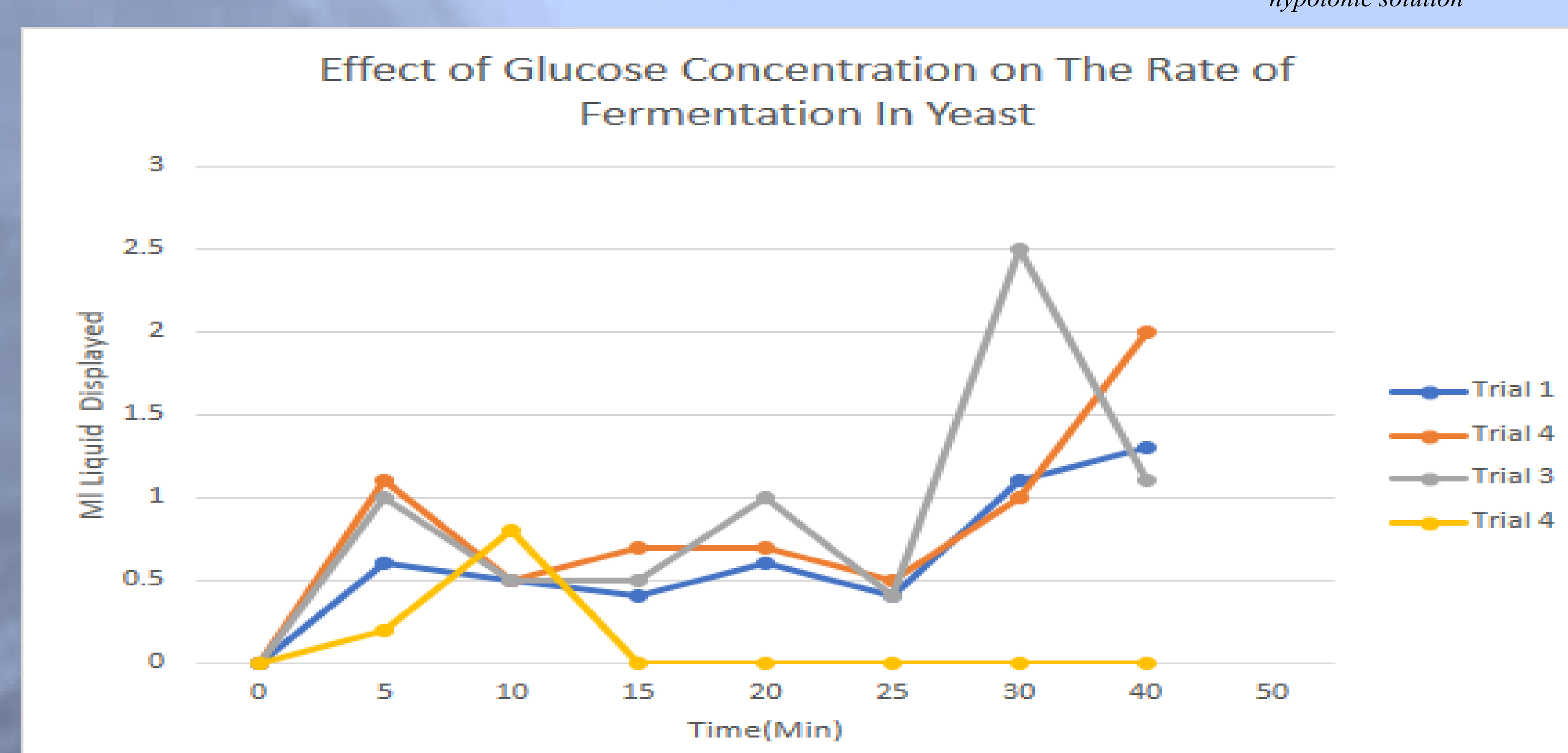

Figure 2. The graph above show how Glucose Concentration can affect the fermentation rate in yeast. None of the four trials show consistent pattern.

Discussion

Before performing both experiments, we predicted that the enzyme concentration and the enzymes will increase. Also, we predicted that our water sample will have the results of being a hypotonic solution. In figure 1 the fermentation rate in yeast is affected by glucose concentrations. The results made in the photosynthesis lab contributes to our hypothesis because in the second graph from figure 2, there is a consistent pattern on the amount of Bicarbonate concentration on the rate of photosynthesis. The initial mass of our water sample was 7.1g and after 45 minutes the mass was 7.6g, resulting in a mass difference of 0.5g with a 7.04% change in mass. Based on the results from figure 3, our water sample Long Island City Deep, is a hypertonic solution. Some possible errors that might have skewed our data:
Not making the appropriate dilutions would not allow us to determine what effect enzymes and substrate concentration have on enzyme activity.
In the Osmosis and Diffusion activity is not tying the string on the bag tight enough.

Conclusion and Future work

Based on our studies we can conclude that the quality of aquatic life depends heavily on the levels of salinity, dissolved oxygen and carbon dioxide. By conducting these experiments, we were able to have a better understanding on how each individual factor affect one another. When the levels of dissolved oxygen and carbon dioxide are out of their optimum range processes such as photosynthesis cannot be carried out normally. The amount of salinity affects aquatic life because certain life organisms acquire a certain amount in order to have a balanced homeostasis. Throughout this research I've learned the heavy impact mankind has on the environment as well as aquatic life. I have gained knowledge of the East River through these experiments because it allowed me to study the effects these factors have on our water quality. Based on what I have learned I can use this advantage to educate others in order to secure a better future to our surroundings. With this data, I learned that the dissolved materials played an important role on aquatic organisms. In the future I can conduct other experiments that would allow me to observe more chemical and physical properties of other water bodies.

References

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