The Peculiarities Of Photosynthesis In Aquatic Plants

RATIONALE

Aquatic plants can be used to demonstrate the oxygen production in the process of photosynthesis because they are specialised to produce oxygen while submerged under water. The common aquatic plant that is used for most of the experiments is Elodea. In theory, when an aquatic plant is placed in a solution in the presence of appropriate light intensity, the plant will photosynthesise and produce bubbles of oxygen gas. These bubbles can be counted and the number of bubbles can serve as an indication of the rate of photosynthesis. When the light intensity is increased, the rate of bubble production should increase and decreased light intensity should do the opposite. According to Global Invasive Species Database, 'Elodea tolerates pH values from 6.0 to 7.5 and temperatures from 1 to 25 degrees Celsius'. The reason for choosing Elodea as the plant for this experiment is that, this plant improves water quality as it is producing and releasing a huge volume of oxygen inside water (source GISD), this quality of the plant makes it the right choice for this experiment. The ocean produces oxygen through the plants like phytoplankton, kelp, and algal plankton etc. The pH value of pure water is 7, which is neutral. However, most plants cannot photosynthesise in low pH levels (plant peril, by JULIE BAWDEN DAVIS, 23/September/2000). The increasing carbon dioxide in the atmosphere is not only affecting life on land, but also in the oceans, rivers and lakes. This experiment is performed to show the optimum environment for aquatic plants and how increasing the acidity of water may cause the aquatic plant to slow their photosynthesis rate. "Carbon dioxide is the most common cause of acidity in water" (Fondriest environmental learning centre, carbon dioxide and pH, 2019). Furthermore, the experiment is performed at a constant light intensity and pH of the elodea plant submerged in will be changed.

Research question

How does decreasing the freshwater pH levels from 10 to 7 and 7 to 1 affect the Rate of Photosynthesis of an aquatic plant; Elodea?

Original Method

The original method measured the rate of photosynthesis by placing the Elodea plant in different light intensities and compared the number of bubbles counted from the different light intensities to get the conclusion that the plant was less effective in photosynthesis when it was placed away from the light source and was more effective when placed near to the light source.

Methodology

The original method was changed because the original experiment was measuring how light intensity is affecting the rate of photosynthesis. However, this experiment is analysing how different pH levels affect the rate of photosynthesis.

Modifications to methodology

To make sure that accurate, relevant data was collected the original experiment was changed to increase the number of dependent variable and measurements, in this case the new experiment has the rate of photosynthesis depending on the pH levels and the controlled light intensity. The reliability of the data collected was improved by making changes to the original methodology (additional improvements). For example, the light intensity was 20 cm away from the plant which was maintained the same for all the three solutions.

Additional improvements to the method

The reliability of the data was improved by making changes to the original methodology these changes include: water being mixed with NaOH in test tube 1 and water being mixed with HCl in test tube 3 this means that the plant was not submerged in pure HCl and NaOH; which is reliable because in oceans and other water bodies the acid is being mixed with water. Additionally, the pH was tested for all the three solutions before the plant was submerged in the test tube. Furthermore, apart from the original method all the solutions were kept the constant distance away from the light source (20 cm).

Risk management

While conducting the practical experiment the significant risk identified is the potential burn caused by accidently touching the light source. The light source produces heat; this can be minimised by staying away from the lamp while observing the rate of photosynthesis. Another potential risk while conducting the experiment is the accidental spillage of acids on the individual's body this can cause skin irritation. Hydrochloric acid (HCl) and sodium hydroxide (NaOH) on the skin can also cause skin burns. To minimise these risks, it is essential that participants wear protective equipment including lab coat, goggles and gloves.

Interpretation

The trend of the graphical representation shows that rate of photosynthesis decreases in the acidic and increases in the basic nature of water. This result can relate as an accurate representation of the ROP in ocean as seen in appendix 1 and 3. For the conducted experiment the mean and standard deviation cannot be calculated because the experiment was only done once for each solution. However, the R2 value for the experiment was 0.9786 and the P value of the experiment data was 0.09340. This means that the data collected has a low reliability as the R2 value was 9.786% accurate. Additionally, the P value of the experiment was 0.09340 from this value it is quite understandable that this data was not significant as the value is higher than 0.05; From the statistical calculations it is clear that there is not a high percentage of chance for a researcher to obtain the same results. The mean and the standard deviation acquired from an online experiment was 7.29 (mean) and 5.127259295 (st.dev). this shows reliability on the online experiment than the actual experiment as the error value was relatively low. All these statistical calculations for the online experiment done by Ruby Jacobs, Tessa Sharma and Zixuan Zhao shows that even though the actual experiment had one trial, on increasing the number of trials the result could have been more accurate to prove that aquatic plants produced more oxygen in basic water.

Analysis

Marine plants contribute a major percentile to maintain 70% of oxygen in the atmosphere. The earth being surrounded with 71% of water (PHYS org; what percent of earth is water?) along with the contribution of the marine plants, maintains the oxygen percentage in the atmosphere. The practical experiment shows that in basic environment aquatic plants produce more oxygen. Global warming is a gradual increase in the overall temperature of the earth's atmosphere generally contributed to the greenhouse effect caused by increased levels of carbon dioxide. From the above secondary research, it stated that "Carbon dioxide is the reason which increases the level of acidity in water" (Fondriest environmental learning centre, 2019). A chemical reaction takes place between carbon dioxide and water that leads to the formation of carbonic acid that converts the basic nature of the ocean water to acidic. This overall reaction results in less oxygen production by the aquatic plants because of the reduction of the rate of photosynthesis. Analysing the results from the experiment it is clear that the data is not reliable and significant which is clearly shown by calculating the R2 and p values. The experiment is theoretically supported by the data collected from the previous experiments performed by Ruby Jacobs, Tessa Sharma and Zixuan Zhao. The practical experiment has certain uncertainty and limitations such as: The water which the Elodea was submerged, Elodea was submerged in fresh water, fresh water mixed with HCl and fresh water mixed with NaOH. So, this report is hypothesising the result from the experiment and linking the result to ocean acidification; This experiment is replacing the carbonic acid with HCl; it was just a prediction that the pH of carbonic acid would be approximately the same as the HCl solution pH (1).The experiment was neither using sea water or sea water plant; So, the experiment is using a fresh water aquatic plant (Elodea) in place of a sea water plant; and predicting that it would give the same results in the rate of photosynthesis. Experimental variation could have happened because of human errors which include errors in counting bubbles, calculating time and errors created in modifying the distance of the light source that could vary between 1 – 2cm.

Evaluation

In the experiment there were several limitations, this limitations could have been occurred due to the experimenter or it could have been the fault of the instruments that is used to calculate measurements; all these factors are also a reason that could affect the reliability of the data. The limitation due to the researcher includes the number of trials for the experiment and the limitation due to the instruments include the precision with the ruler.

Sources of error

The experiment had a various number of errors. These errors are affecting the reliability of the data produced. Some of these errors include variations in the ruler measurements, variations in the measurement of the liquids used in this report and variations in placing the plant 20cm away from the light source.

Affecting reliability

According to the secondary researches it is sure that if another researcher performed the same experiment with different aquatic plants the results will show variations maintained under same conditions, for example the aquatic plant hydrilla shows an increase rate of photosynthesis when carbon dioxide levels are increased as seen in appendix 2. The photosynthesis efficiency increases in a proportionate manner with the rise of carbon dioxide concentration up to a certain

limit at a particular light intensity for hydrilla. The light intensity and duration of exposure to light are some of the principal limiting factors of photosynthetic process in green plants. However, the data collected from this experiment is not reliable as the number of trials was less.

Affecting validity

The validation of the experiment can show variation in the results when different acidic and basic solutions have been used in the experiment. The rate of photosynthesis is moderate when the solution is water which has a pH rate of 7. There would be increase or decrease in the rate of photosynthesis when the pH is adjusted between 1 to 7 in case of acidic solution and 7 to 10 in the case of basic solution. Which has been proven in the experiment.

Improvements and extensions

The experiment has a various number of errors to overcome these errors, some improvements and extensions are mentioned below.

Suggested improvements

The experiment can be improved when minimum of three aquatic plant species that would be tested under same conditions, in this manner it would help to compare the results for certain accuracy towards ocean acidification. The experiment could also be improved by having a constant height for the different plants; by having more than one trial for each solutions and the experiment could collect the volume of gas to get a more reliable data.

Suggested extensions

The experiment could be extended when the aquatic plant is tested with different solutions at more than two different pH rates. This would help to have an idea about the purity that has to be maintained in the water bodies and also to reduce the rate of CO_2.

Conclusion

In conclusion, the hypothesis of acidic water decreases the rate of photosynthesis and basic water increases the rate of photosynthesis is accurate for some extent; however additional experiments are needed to prove that this result is an accurate representation to state that the rate of photosynthesis is affected by the increasing amount of carbon dioxide in the ocean. This experiment could be improved by having more than two aquatic plants and more varying pH solutions. This experiment could also be improved by having a constant height maintained in front of the light for all the different solution and increasing the time of the experiment for each plant.

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