# Effect of light intensity on photosynthesis

Plants which obtain energy from sunlight and carbon dioxide to make carbohydrates are the process called photosynthesis. Then plants will take carbon dioxide from the atmosphere, add some water and use the energy of sunlight to form sugar. The overall equation can be summarized as below:

$6CO_2 + 6H_2O \quad C_6H_{12}O_6 + 6O_2$

In biology, the requirements for photosynthesis are chlorophyll, carbon dioxide, light and water. In fact, most of photosynthesis occurs in the chloroplast, Chlorophyll absorbs sunlight then converted to chemical energy during the process of photosynthesis.(Campbell 2008)

There are two stages for photosynthesis. They are light reaction and dark reaction. Firstly, light energy splits water into oxygen and hydrogen during the light reaction. Then NADP and hydrogen add together and form $NADPH_2$. After that, oxygen atoms join each other and form $O_2$, at this time it released in the atmosphere.(Bailey 1997) Moreover, light energy generates ATP from ADP. The light reaction can also be summarized as below:

$2H_2O + NADP + ADP + P \xrightarrow{\text{sunlight, Chlorophyll}} O_2 + NADPH_2 + ATP$

Hydrogen is transferred into dark reaction. Then oxygen is released. It only occurs in the presence of light. Therefore, $NADPH_2$, $O_2$ and ATP are the products of light reaction.

Secondly, carbon fixation occurs in the dark reaction has shown as below:

$ATP + NADPH_2 + CO_2 \longrightarrow ADP + P + NADP + glucose$

Enzyme use NADPH2 and ATP as the energy to convert to carbon dioxide. And carbon dioxide is absorbed from the atmosphere in dark reaction.(Bailey 1997) And then CO2 is converted into carbohydrates such as glucose.

The concentration of water, carbon dioxide, the temperature and the light intensity are the most common environmental factors to affect photosynthesis (Lincoln 2010). So the aim of this scientific experiment is to investigate the effects of light intensity on the rate of photosynthesis.

## Methods

Kept all the beakers and test tubes to be used on ice. Stalks are removed from leaves and leaves are ground in 200mL solution of buffer A. Buffer A was a mixture of potassium dihydrogen orthophosphate 10mM, disodium hydrogen orthophosphate 10mM and magnesium chloride 5mM. Then the extract is poured through the two layers of muslin into a beaker and suspension is also poured through eight layers of muslin into other beaker. The centrifuge spun the suspension at full speed in one minute. Then suspension is poured off and green chhloroplast is produced in total of 15mL solution of buffer C and it stored in ice for use. Buffer C was a solution same to buffer A but without magnesium chloride.

Used the different pipettes to perpare the solution of buffer B at 6. 7mL and 0. 2mL chloroplast solution into a test tube. Mixed each solution well. Zero the spectrophotometer using 1. 0mL of mixture at absorbance wavelength of 590nm. The spectrophotometer is used to measure how much light that the mixture absorbed.

Used the different pipettes to prepare the solution of buffer B at 6. 7mL, 0. 2mL of chloroplast solution and 0. 1mL of the dye into another test tube. Mixed each solution well and put it into the cuvette. The cuvette was placed at 0. 3m for 60s from the lamp and the optical density of 1. 0mL of this solution was measured with the spectrophotometer. All readings noted in the table and the optical density of solution was measured again. Repeated the same process at 0. 5m, 0. 7m, 0. 9m, 1. 0m from the lamp and each distance had a new mixture.

The chloropast solution should kept in ice in this experiment to make sure that the solutions did not have any reaction until they placed under the light. Recorded the optical density at 590nm in each different distance from the lamp.

## Results_____

Rate of dye reduction

Distance from light intensity (m)

The graph shows that the distance from light intensity are increased when the rate of dye reduction decrease between 0. 3m to 1. 1m. That mean the rate of photosynthesis also decreases in this graph. The maximum rate of dye reduction is 0. 398 at 0. 3m from the light and the minimum rate of dye reduction is 0. 045 ate 1. 1m from the light. According to the data of the above graph, Q1= 0. 065, Q3= 0. 345 and IQR = 0. 28. The lowest rate of dye reduction is 0. 065-1. 5 x 0. 28 = -0. 355. In this case the lowest rate of dye reduction from the data lies above -0. 355, so there is no outlier. On the

other hand, the upper rate dye reduction is 0. 345+1. 5 x 0. 28 = 0. 765. Hence there is no outlier also. The data are positively skewed distribution because the data trend from the left to the right.

## Discussion

During the photosynthesis, the light intensity will increase when the rate of photosynthesis increase.(Pang 2006) In my result, the distances from light intensity are increased when the rate of photosynthesis decreases, which mean when the light intensity decrease, the rate of photosynthesis also decreases. In this case, my result is true.

There are some experimental errors in this experiment. It is hard for us to make sure the chloroplast solution will not active until they were placed under the lamp because there were the other light from the surrounding in the room such as neighbour lamps. So the experiment should be done in a dark room that can reduce the effect of the light and the result will become more accurate . Also, more cuvette should be provided because it will effect the result if some of cuvette was not clean well.

Moreover, there are some limitations in this experiment. Different solution should be used different pipette to prevent the other solution will add on the result. Also, meaured the volume of each solution that can help to reduce variations. Furthermore, placed the test tube of chloroplasts in the ice because this can ensures the temperature of the test tube is not affected by the heat realeased from the lamp. As temperature might affect the enzyme activity of the plant and hence the rate of photosynthesis.

Light is needed for photosynthesis in plants. When chloroplasts in the leaf’s cell are facing to light, they form ATP from ADP. Oxygen is produced during the photosynthesis. (Campbell 2008) According to my result, light energy increases when more water molecules are split into oxygen. At this time, the light reaction occurs faster and more ATP and NADPH2 are produced. Therefore, it will have more sugar and oxygen formed in dark reaction. In this case thre rate of photosynthesis increases.