Department of Biology and Biochemistry

Biol111

Exp #6: Cellular Activity

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Cellular activity

Objectives:

1.The aim of the photosynthesis experiment: to see the effect of different factors such as light and temperature on the rate of photosynthesis.

2.The aim of the fermentation experiment: to measure the volume of CO_2 produced during the fermentation of different carbohydrates by yeast cells under an aerobic conditions.

Introduction:

- the issue we are studying is: what is the effect of different factors on cellular activities (photosynthesis and fermentation) on measuring the volumes of O_2(ml) and CO_2(ml)?

Materials and method:

- in the photosynthesis experiment: we used 7 funnels and filled each with 10 Geranium leaves, then we inserted the funnel upside-down in the Beakers, we added 0.5% sodium bicarbonate ($NaHCO_3$) to each as a source of CO_2, and then we closed the funnels that is filled with the Geranium leaves and the sodium bicarbonate ($NaHCO_3$) using up-down graduated test tubes that is also filled with sodium bicarbonate ($NaHCO_3$) ,to measure the volume of O_2 in (ml) that will be seen as (O_2) bubbles that moves to the Top of the graduated test tubes, and finally we highlighted each Beaker by different course of light (40W, 150W, Dark, room light) and different temperatures(ice bucket, 50 ℃, room temperature), we took notes and measured the volume of the O_2 every 10 minutes in (ml) to each, and we took the beaker that has the room temperature and room light as the control that we will compare each beaker with; to see the difference and the effect of these factors on the O_2 production, because the photosynthesis depends on the O_2 volume (the more oxygen produced the higher rate of photosynthesis) as the following equations:

1) $6CO_2 + 12H_2O \xrightarrow{\text{Light + chlorophyll}} C_6H_{12}O_6 + 6O_2 + 6H_2O$

2) $H_2O \rightarrow O_2 + 2H^+ + 2e^-$ **3)** $NADP^+ \rightarrow NADH$ **4)** $CO_2 \rightarrow$ Organic Compound

- in the fermentation experiment: we brought 5 flasks that are each filled with different carbohydrate (Sucrose, Glucose, Galactose, Molasses, Water) and we added 10% of each to another 5 fermentation tubes, then we added more 10% of fermented yeast solution to the fermentation tubes, then we set all of the 5 fermentation tubes in a water that has a temperature of 37 ℃ (because it is the temperature that the yeasts bacteria lives in), and then we measured the volume of the CO_2 every 5 minutes in (ml), and we took the tube that contains water as the control tube that we will compare each fermentation tube with; to see the difference and the effect of these carbohydrates on the production of CO_2, because the fermentation depends on the CO_2 volume (the more CO_2 produced the higher rate of fermentation) as the following equation:

$C_6H_{12}O_6 \xrightarrow{\text{fermentation}} 2C_2H_5OH + 2CO_2 + \text{ATP and Heat}$

Data:

__ we collected the volumes of O_2 in the photosynthesis experiment every 10 minutes, and the volume of CO_2 in the fermentation experiment every 5 minutes.

__ we observed the effect of each factor on booth experiments.

Results:

Table1: Volume of O_2 (ml) collected in the graduated test tubes under different environmental conditions for 80 minutes:

Time (mins)	Dark / Room temp	Room Light / Room temp CONTROL	40 Watt Light / Room temp	150 Watt Light / Room temp	On ice / Room temp	50 ℃ / Room temp	With water
0	0	0	0	0	0	0	0
10	0	0.15	0	0.3	0	0.06	0.1
20	0	0.15	0.1	0.4	0	0.08	0.2
30	0	0.25	0.12	0.42	0	0.1	0.25
40	0	0.26	0.15	0.5	0	0.2	0.25
50	0	0.5	0.30	0.85	0	0.3	0.25
60	0	0.57	0.35	0.9	0	0.9	0.25
60	0	0.65	0.37	1.0	0	0.9	0.25
80	0	0.65	0.39	1.1	0	1.0	0.3

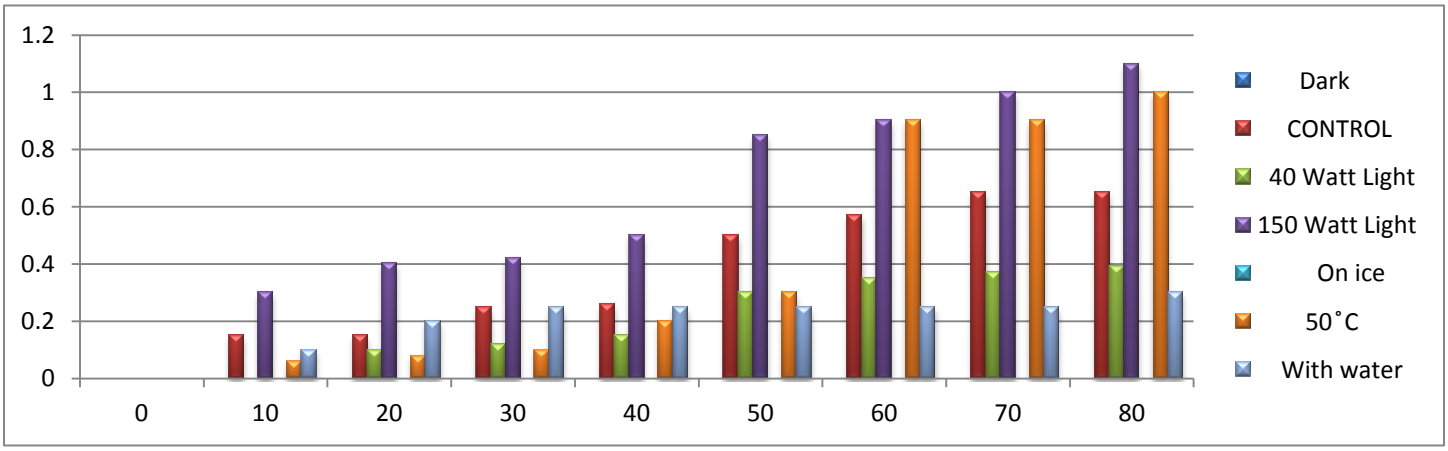

figure1: Volume of O_2 (ml) collected in the graduated test tubes under different environmental conditions for 80 minutes

Table2: volume of CO_2 (ml) collected in the fermentation tubes for 40 minutes :

Time (mins)	Sucrose	Glucose	Galactose	Molasses	Water CONTROL
0	0	0	0	0	0
5	0	0	0	0	0
10	0	0	0	0	0
15	0	0	0	0	0
20	1.5	2.5	0	3.0	0
25	2.5	4.5	0	3.9	0
30	3.4	4.5	0	4.5	0
35	4.0	5.0	0	4.9	0
40	4.5	5.0	0	5.0	0

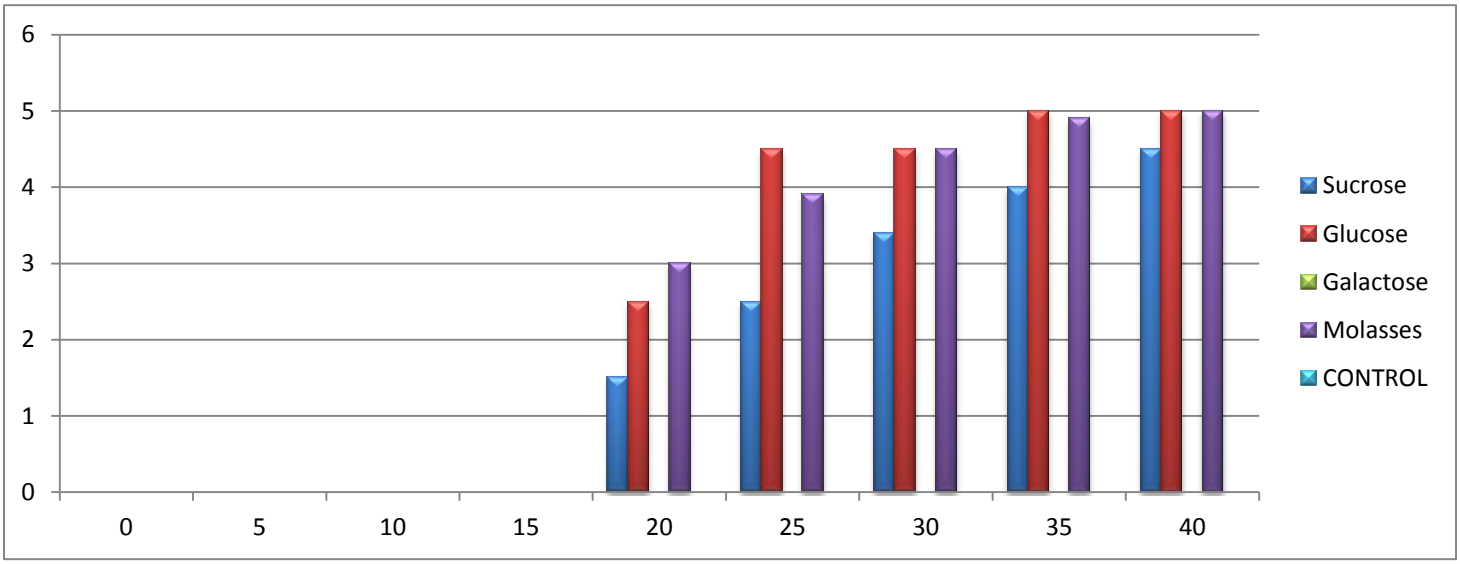

figure2: Volume of CO_2 (ml) collected in the fermentation tubes for 40 minutes

-Discussion:

as shown in **figur1** we noticed that the volume of the O_2 was increasing in a fast way in the beaker that was highlighted to 150 Watt Light comparing with the CONTROL, and on the other hand we can see the results when the breaker was set in the darkness gave us a zero volume of O_2, these results proofs for us that the amount of light highlighted to the beakers effects the rate of photosynthesis, as following: the more light collected by the chlorophyll pigments, the more O_2 obtained from the H_2O splitting molecules by the light's ATP, the more protons (H^+) obtained which are provides the energy, so the more NADH obtained that needed in the second process of the photosynthesis (Calvin cycle), the more rate of photosynthesis the chloroplasts can make.

also we noticed that the volume of the O_2 was increasing in a fast way in the beaker that has a temperature of 50 ℃ comparing with the CONTROL, and on the other hand we can see the results when the breaker was set in the ice bucket gave us a zero volume of the O_2, these results proofs for us that the temperatures of the beakers effects the rate of photosynthesis, as following: the more heat the plants gets, the more O_2 obtained from the H_2O splitting molecules bye the heat's ATP, the more protons (H^+) obtained which are provides the energy, so the more NADH obtained that needed in the second process of the photosynthesis (Calvin cycle) , the more rate of photosynthesis the chloroplasts can make.
in the sum of both results of the light and the temperature, we can say that they gave us the same results to the photosynthesis General equation :
$6CO_2 + 12H_2O \xrightarrow{Light + chlorophyll} C_6H_{12}O_6 + 6O_2 + 6H_2O$

and in **figure2** we noticed that the results for the Glucose fermentation tube and the Molasses fermentation tube were close in the volume of the CO_2 , which was increasing very fast comparing with the CONTROL, and we can notice that the Sucrose fermentation tube had a smaller volume of the CO_2, on the other hand we can see the results in the Galactose fermentation tube and Water(CONTROL) fermentation tube gave us a zero volumes of the CO_2, these results proofs for us that the volume of CO_2 effects the rate of fermentation as following : the more CO_2 obtained, the more rate of fermentation. and as the fermentation General equation:
$C_6H_{12}O_6 \xrightarrow{fermentation} 2C_2H_5OH + 2CO_2 + ATP$ and Heat.

Conclusion:

there were no errors in both experiments and we concluded that the volume of the O_2 effects the rate photosynthesis and the volume of the CO_2 effects the rate of fermentation .