

Formal Lab Report: Cellular Respiration and the Effects of Pollutants on Its Rate

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Abstract

The purpose of this experiment is to understand the how important cellular respiration is in the processes of life. We were also trying to discover the effect on the rate of cellular respiration with changes in a supply of carbohydrate. We tested if pollutants in an environment harm life by disrupting organisms ability to perform cellular respiration. We were looking for how cellular respiration works in small organisms with yeast. We were looking for the amount of gas produced to determine the amount of carbon dioxide was created after the yeast carries out cellular respiration. We were looking for how carbohydrates affected cellular respiration, we added sugar to the yeast after the first test, we were looking for more carbon dioxide which determined that the rate of cellular respiration increased. We were looking for the pollutants to have an effect on the cellular respiration rate. We added different pollutants to the yeast and measured the amount of carbon dioxide to determine how the pollutant affected the cellular respiration rate.

To conduct the experiment we added yeast and water together. We poured the yeast mixture into a test tube and placed another test tube on top. We flipped the tube upside down filling the cap tube with the yeast mixture. Then we observed the amount of gas produced at the top of the tube to over 10 minutes to determine the cellular respiration rate. To discover how carbohydrates effect the rate of cellular respiration we added granulated sugar to the yeast mix. We poured this mixture into a test tube, covered it, and flipped it like the original mixture and measured the amount of gas over 10 minutes. To observe the pollutants effects on cellular respiration we added a pollutant into the carbohydrate mixture. The pollutants used were: isopropyl alcohol, vinegar, salt solution, baking soda, bleach solution, and soap solution. The

previous method was used to determine the pollutant effects. Each group was assigned a different pollutant for each group.

As a result we found what we were looking for. We observed the yeast mixture for 10 minutes, we compared it to the yeast-sugar mixture. The yeast-sugar mixture had a faster rate of cellular respiration. The results of our pollutants had mixed results. Most of the pollutants used had a lower rate of cellular respiration. Baking soda was the only pollutant that had a higher rate of cellular respiration instead of a lower rate.

Introduction

The purpose of the experiment is to discover how the role of cellular respiration in the processes of life. Cellular respiration is the process of chemical energy in food is harvested and converted into a form of energy that is used to carry out the process of life. The objectives were to discover how the rate of cellular respiration is affected by the presence of carbohydrates and if the rate was affected by pollutants. Our hypotheses were an organism will have a larger rate of cellular respiration with a source of carbohydrate than without a source of carbohydrate. An organism will have a lower rate of cellular respiration with a source of carbohydrate and a pollutant than in a source of carbohydrate and no source of pollutant.

To test the first hypothesis take the yeast and mix it together with the water. Then pour the yeast mixture into a test tube, take a slightly wider test tube and place it over the test tube with the yeast. Flip the test tubes and over the time span of 10 minutes observe the amount of gas created at the top of the tube. During observation log the amount of gas every minute within the 10 minutes. Then create a yeast-water mixture but add granulated sugar into the mixture. Place it into a test tube and place the larger tube on top. Flip the tube and repeat the process of recording

for the first yeast mixture. In the results the yeast with the granulated sugar had more gas than the yeast without the sugar. Therefore the yeast mixed with the sugar had a larger rate of cellular respiration.

To test the second hypothesis create another mixture of carbohydrate and yeast. Add the pollutant assigned to the group into the mixture. Pour it into a test tube and place a slightly larger one over it. Flip the test tube and repeat the same process for the other two tests done. In the results the pollutant mixture had a smaller amount of gas than the carbohydrate mixture. Therefore the pollutant mixture had a lower rate of cellular respiration than the carbohydrate mixture. At the end of the experiment the hypotheses were supported by the results of the experiment.

Methods

Take the wax marker and label the two 25mL x 250mL test tubes, two 15mL centrifuge tubes, and two 50 mL beakers. Write Y for yeast, W for water, and S for sugar. Take the tubes and place them into the test tube rack. Pour 150mL of hot tap water into the 250mL beaker. Take 2.5mL of yeast and pour it into beaker#1. Take 2.25mL of yeast and 2.5mL of granulated sugar and pour both into beaker #2. Swirl the beaker to mix the sugar and yeast together. Add 13mL of warm tap water into each beaker, swirl each beaker thoroughly to mix them. Pour the solution of beaker#1 into test tube#1. Invert test tube#1 and place over centrifuge tube#1. Use a finger of one hand to push the centrifuge tube #1 up into the inverted test tube #1. Hold it in that position while holding test tube#1 with the other hand. Quickly invert test tube#1 back into normal upright position with one hand while applying pressure to centrifuge#1 against the bottom of test tube #1. Find the initial gas volume in centrifuge tube# 1 and record the value for time=0. Place

tube#1 and centrifuge tube#1 into the 250mL beaker with hot water to speed up the reaction time. Repeat the same steps for beaker #2 , centrifuge tube# 2 and test tube# 2. Record and find the volume of gas in each centrifuge tube at 1 minute intervals over a period of 10 minutes. Clean up by pouring all the solutions and water down the sink. Wash each beaker and test tube properly.

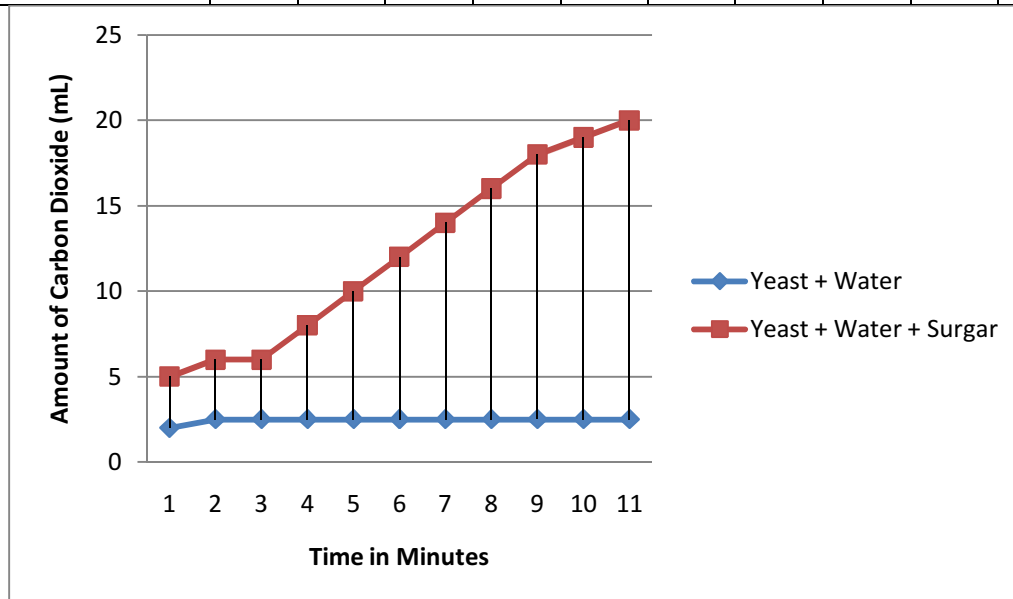
Place 150mL of hot tap water into the 250mL beaker. Take 2.5mL of yeast and 2.5mL of granulated sugar and pour both into the 25mL beaker. Swirl the beaker to mix the yeast and sugar. Add 10mL of warm tap water into the 25mL beaker and swirl each beaker to mix them together. Add 3mL of the simulated pollutant that was assigned to the group. Repeat the method to transfer the contents of the 25mL beaker to the centrifuge tube and invert the centrifuge tube into the test tube. Find the initial gas volume in the centrifuge tube and record the value for time=0. Place the centrifuge tube into the 250mL beaker with hot water to speed up the reaction time. Record and find the volume of gas in the centrifuge tube at 1 minute intervals over a period of 10 minutes. Calculate and record the rate of cellular respiration in each of the tubes as total volume of CO₂ produced divided by the total number of minutes. Clean up by pouring all the solutions and water down the sink. Wash each beaker and test tube properly and wipe up and dry or wet materials left behind.

Results

Gas (CO₂) volume (mL) at 1 minute intervals for 10 minutes for centrifuge tube containing yeast and water versus centrifuge tube containing yeast, water, and sugar.

Amount of gas over 10 min

Tube		Gas volume (mL) in Centrifuge Tube at Time (min)											
#	Contents	0	1	2	3	4	5	6	7	8	9	10	
1	Yeast + Water	2	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5
2	Yeast + Water + Sugar	5	6	6	8	10	12	14	16	18	19	20	



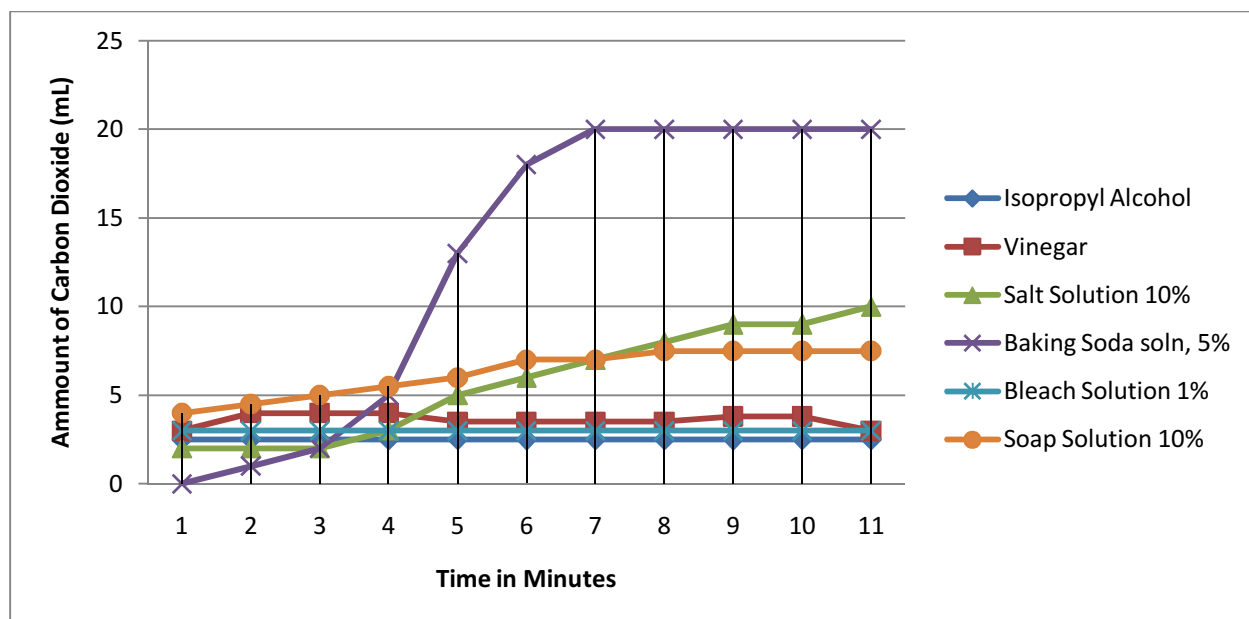
The results show that the yeast had a higher rate of cellular respiration with a source of carbohydrate. The yeast and water solution only produced 2.5ml amount of carbon dioxide within the first minute. For the remaining 10 minutes of the interval the yeast did not create any

more carbon dioxide. The yeast, water, and sugar solution produced 5 mL carbon dioxide with in the first minute. At 4 minutes the carbon dioxide increased to 10mL and at the end of the 10 minutes interval it created 20mL of carbon dioxide.

Gas (CO₂) volume (mL) at 1 minute intervals for 10 minutes for 6 centrifuge tubes, each containing yeast, water, sugar, and one of six simulated pollutants.

Amount of Carbon dioxide in 10 minutes

Group#	Simulated Pollutant	Gas Volume (mL) in Centrifuge Tube at Time (min)										
		0	1	2	3	4	5	6	7	8	9	10
1	Isopropyl alcohol	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5
2	Vinegar	3	4	4	4	3.5	3.5	3.5	3.5	3.8	3.8	3
3	Salt Solution, 10%	2	2	2	3	5	6	7	8	9	9	10
4	Baking Soda soln, 5%	0	1	2	5	13	18	20	20	20	20	20
5	Bleach solution, 1%	3	3	3	3	3	3	3	3	3	3	3
6	Soap solution, 10%	4	4.5	5	5.5	6	7	7	7.5	7.5	7.5	7.5



The isopropyl alcohol solution produced 2.5mL of carbon dioxide and did not create any more carbon dioxide through the 10 minute interval. The vinegar created 3mL of carbon dioxide and increased to 4mL and dropped down to 3.8mL. The salt solution created 2mL of carbon dioxide and increased to 10mL at the end of the 10 minute interval. The baking soda solution created 0mL at the beginning of the interval but had a rapid increase in carbon dioxide. At 6 minutes the baking soda solution created 20mL of carbon dioxide and remained at 20 through the rest of the interval. The bleach solution created 3mL of carbon dioxide at the start of the interval, it did not create any more carbon dioxide through the 10 minute interval. The soap solution created 4mL of carbon dioxide and slowly increased to 7.5mL in 7 minutes, it did not increase any further than 7.5mL.

Total volume of CO₂ produced and cellular respiration rate (mL/min) for 8 combination of yeast, water, sugar, and simulated pollutant.

Tube Contents	Total Volume of CO ₂ Produced	Cellular Respiration Rate (mL/min)
Yeast + water	.5	.05
Yeast + water + sugar	15	1.5
Yeast + water + sugar + isopropyl alcohol	2.5	.25
Yeast + water + sugar + vinegar	0	0
Yeast + water + sugar + salt solution, 10%	8	.8
Yeast + water + sugar + baking soda solution, 10%	20	1.8
Yeast + water + sugar + bleach solution, 1%	0	0
Yeast + water + sugar + soap solution, 10%	3.5	.35

Discussion

The hypotheses were an organism will have a larger rate of cellular respiration with a source of carbohydrate than without a source of carbohydrate and an organism will have a lower rate of cellular respiration with a source of carbohydrate and a pollutant than in a source of carbohydrate and no source of pollutant. The hypothesis that an organism will have a larger rate of cellular respiration with a source of carbohydrate than without a source of carbohydrate is fully supported from this experiment. The cellular respiration rate in the carbohydrate mixture

was larger than the cellular respiration than the regular yeast mixture. The reason why this happened is because our yeast had a source of energy. In order to carry out cellular respiration the organism needs a source of energy, the fuel the organism used the granulated sugar as a source of energy. (Rhein 2009) Since the yeast had a source of energy it could go through the processes of cellular respiration more than it could without having any source of energy.

The hypothesis that an organism will have a lower rate of cellular respiration with a source of carbohydrate and a pollutant than in a source of carbohydrate and no source of pollutant is supported by this experiment. The results had that the mixtures with the simulated pollutants all had a lower cellular respiration rate than a carbohydrate mixture with no pollutants. The reason why this happened is because most of pollutants used were harmful to living organisms. (Brown 1995) Most of the pollutants used in this experiment were harmful to the yeast disabling its ability to carry out cellular respiration. There was one pollutant that had actually increased the rate of cellular respiration, baking soda. The reason this happened is because baking soda has some molecules similar in carbohydrates such as hydrogen, carbon, and oxygen. (Schumacker 1993)

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