

Rate of Decomposition of Hydrogen Peroxide as a Function of Catalase
Concentration

Performed: Herrin High School

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INTRODUCTION

Purpose: To determine how the concentration of an enzyme affects the rate of a reaction.

The enzyme catalase speeds up the breakdown of hydrogen peroxide into water and oxygen gas. The reaction is described by the following chemical equation:



Hypothesis: As concentration of the enzyme catalase is increased, the rate of decomposition of hydrogen peroxide is also increased.

MATERIALS

- Seedless watermelon. Watermelon extract solution (100%)
- Blender
- 1200 mL (32 mL/group) 3% hydrogen peroxide solution (H_2O_2)
- 5 50-mL beakers
- 4 60 X 15 mm Style Petri dish lids
- 1 90 X 15 mm (Quad separated Petri dish)
- 10 mL graduated cylinder
- Distilled water
- Card stock paper disks (12 paper disks will be needed).
- Forceps
- Single hole punch
- Paper towels
- Stop watch, wrist watch, or clock (time piece)

PROCEDURES

1. Use the single hole punch to create 12 filter paper disks.
2. Catalase is found in watermelon extract. The negative control in our experiment will be the 0% concentration of watermelon. Since this concentration will not give any results, it will not be tested by your group. Locate the 50-mL beakers containing different concentrations of watermelon extract. (25%, 50%, 75%, & 100%) Use the plastic pipette to deposit a small amount of these four solutions of watermelon extract into the plastic Petri dish lids. Less than 2-mL of each solution will actually be needed.
3. Pour a small amount of extract from each of the 50-mL beakers into the Petri dish lids. Place the Petri dishes on the correct location of the catalase Solutions Label Sheet. Pour 8 mL of the 3% H₂O₂ solution into each of the four troughs of the 90 X 15 mm (Quad separated Petri dish).
4. Using the forceps, place three filter paper disks into the Petri dishes labeled 25% , 50%, 75%, & 100% watermelon extract. Keep the disks in the solutions. There is no need to place any disks into the 0% catalase solution as this is the negative control. Remove each disk as needed.
5. Place a disk from the 25% solution on a paper towel for 4 seconds to remove any excess liquid. Be sure to remove any excess watermelon extract. This process may require turning the disk over and over or moving it back and forth with the forceps.

6. Using the forceps, transfer the filter paper disk to the bottom of one of the Petri dish lids labeled H_2O_2 . The enzyme in the watermelon catalyzes the formation of bubbles of oxygen gas, which causes the disk to rise to the surface.
7. Release the filter paper disk by pushing it quickly to the bottom of the lid using the forceps. Have one person in your group measure how long it takes for the bubbles to carry the disk to the top of the lid. Important! Time begins when the disk is placed at the bottom of the Petri dish. The time stops when any portion of the filter paper disk reaches the top of the hydrogen peroxide. Record the rising time of the disk, in seconds, for each trial into Data Table 1.
8. Repeat step five twice more.
9. Repeat steps three through seven for each of the three remaining watermelon extract solutions. Remember the 0% watermelon solution will yield an extremely long rising time. This solution acts as the negative control.
10. Calculate the average rising time for each of the watermelon extract solutions. Record this information in Data Table 1.

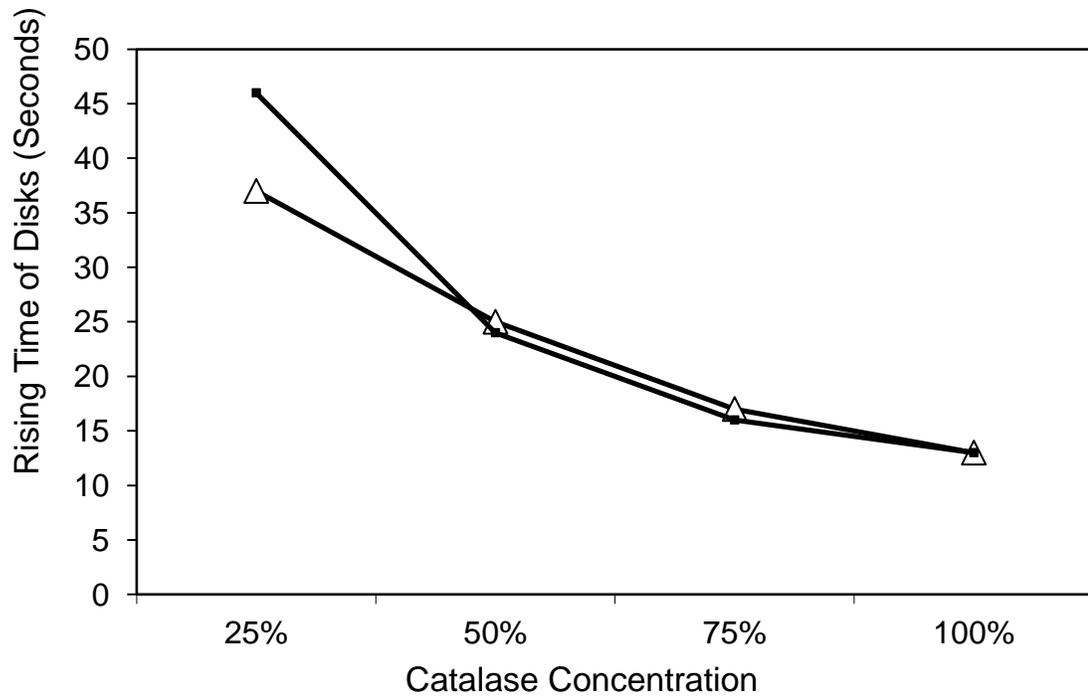
RESULTS

Watermelon (Catalase) Solution	T1 Rising Time	T2 Rising Time	T3 Rising Time	Average Rising Time T1
0%	-----	-----	-----	-----
25%	35	43	33	37
50%	23	25	27	25
75%	16	20	14	17
100%	13	15	11	13

Figure 1: Data Table 1(Group 1)

	Graph 1 Average (Seconds)	Graph 2 (All) Groups Avg. (Seconds)
25%	37	46
50%	25	24
75%	17	16
100%	13	13

Figure 2: Data Table 2 (Comparison of Group 1 with All Groups)



Graph 1: Comparison of Group 1 with All Groups

DISCUSSION

Four different concentrations of watermelon extract were tested within each group. These concentrations were obtained using a dilution table.

Solution	Watermelon Extract	Distilled Water
0% Watermelon Extract	0 mL	1000 mL
25% Watermelon Extract	250 mL	750 mL
50% Watermelon Extract	500 mL	500 mL
75% Watermelon Extract	750 mL	250 mL
100% Watermelon Extract	1000 mL	0 mL

Each lab group tested 25%, 50%, 75%, and 100% watermelon concentrations containing the respective catalase concentrations. Three rising time trials were tested for each concentration of watermelon extract. Eight milliliters of hydrogen peroxide was used for each of three rising time trials. An average rising time was obtained for each of the trials, then recorded in *Data Table 1*. This data was also recorded in *Data Table 2*.

Group 1 Data: After testing the 25% watermelon extract, the average rising time was 37 seconds. After testing the 50% watermelon extract, the average rising time was 25 seconds. After testing the 75% watermelon extract, the average rising time was 17 seconds. After testing the 100% watermelon extract, the average rising time was 13 seconds. This data supports the hypothesis when concentration of the enzyme catalase is increased the rate of decomposition of hydrogen peroxide is also increased.

All Group Data: After averaging all rising times for eleven groups, the 25% watermelon extract resulted in a rising time of 46 seconds. 50% watermelon extract resulted in 24 seconds of rising time. 75% watermelon extract resulted in

a rising time of 16 seconds, and the 100% watermelon extract resulted in a rising time of 13 seconds. This data was consistent with the hypothesis as concentration of the enzyme catalase is increased, the rate of decomposition of hydrogen peroxide is also increased.

CONCLUSION

As concentration of the enzyme catalase is increased, the rate of decomposition of hydrogen peroxide is also increased.

REFERENCES

Johns, Eric. (September 12, 2017). *Chapter 2 Lab: Three, Two, One...BLASTOFF!* Retrieved from: goo.gl/4DZefy