

# Factors affecting the rate of enzymes activity biology essay



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Enzymes are catalysts made within the human body. Catalysts naturally, lower the activation energy required for reactions. The lower the activation energy is, the faster the rate of reaction is, and therefore enzymes speed up reactions in the body by lowering the activation energy required. (Diet-Health. net)

There are many factors that contribute to the rate of reaction of an enzyme. Factors include: concentration of the enzyme, temperature, pH level, concentration of the substrate, and inhibitors. This lab shows the affects these factors have on the rate of reaction between catalase, an enzyme found in potatoes, and hydrogen peroxide, the substrate.

The specific enzyme that was studied during this lab was catalase. Catalase is a naturally occurring enzyme that is found in many living organisms such as plants and the human body. Catalase breaks down hydrogen peroxide, a very harmful oxidizing agent for cells (Catalase). A single catalase molecule can break down millions of hydrogen peroxide molecules in a given moment. Catalase breaks down hydrogen peroxide into water and oxygen. Hydrogen peroxide is a natural waste product which forms when the body breaks down fatty acids and converts that into energy. Hydrogen peroxide also forms when white blood cells break down and kill bacteria in the body. Catalase is also helpful in prevent the formation of carbon dioxide bubbles in the blood. Catalase can help break down other harmful chemicals in the body such as alcohol, phenol, and formaldehyde (VitaminStuff. com).

As mentioned before, enzymes play a significant role in organic chemistry. Catalase is one of the most recognized enzymes found in living organisms.

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This lab provides the clear and understandable information of the enzyme being studied, catalase, and proves the affects of the factors that contribute to an enzyme's rate of reaction.

## **Part 1: Change in Enzyme Concentration**

Table 1:

Enzyme concentration & compositions

Distance (cm)

Time (s)

Rate of Change (cm/s)

Other observations

100 % concentration (10 mL potato juice)

8 cm

3. 02 s

2. 65 cm/s

- bubbles appeared

80 % concentration (8 mL potato juice, 2 mL distilled water)

8 cm

5. 06 s

1. 58 cm/s

- fewer bubbles than previous composition

60 % concentration (6 mL potato juice, 4 mL distilled water)

8 cm

6. 28 s

1. 27 cm/s

- fewer bubbles than previous composition

40% concentration (4 mL potato juice, 6 mL distilled water)

8 cm

7. 5 s

1. 07 cm/s

- fewer bubbles than previous composition

20% concentration (2 mL potato juice, 8 mL distilled water)

8 cm

19. 65 s

0. 41 cm/s

- no bubbles appeared

Graph 1:

Analysis 1:

According to the observation graph 1, the major trend shows that as the concentration of the catalase, which is in the potato juice, increases there is also an increase in the rate of reaction. As the concentration of the catalase decreased, the rate of reaction also decreased.

## **Part 2: Change in Temperature**

Table 2:

Temperature (°C)

Distance (cm)

Time (s)

Rate of Reaction (cm/s)

10.0

8.00

5.85

1.38

21.0

8.00

4. 83

1. 66

35. 0

8. 00

2. 99

2. 68

50. 0

8. 00

4. 21

1. 90

80. 0

8. 00

5. 52

1. 45

Graph 2:

Analysis 2:

Observation graph 2 shows the relationship between the environmental temperature and the rate of reaction. According to the observation chart the optimal temperature was 35°C. The optimal temperature being the temperature at which the enzyme reacted the fastest. Any temperature higher or lower than 35°C, the catalase molecules did not react as fast.

### **Part 3: Change in pH Level**

Table 3:

Amount of H<sub>2</sub>O<sub>2</sub> (mL)

Amount of Distilled Water (mL)

Amount of pH Buffer (mL)

pH Level

Vertical Distance Travelled by Filter Paper Towards Meniscus

Time taken by filter paper disc to move to meniscus (s)

Upward velocity of Filter Paper Disc (cm/s)

10 mL

5 mL

—

7 (Control)

8. 15

6. 6

1. 23

10 mL

—

5 mL

2

7. 98. 15

16. 65

0. 47

10 mL

—

5 mL

4

8. 15

7. 05

1. 16

10 mL



—

5 mL

9

8.1

10.4

0.78

10 mL

—

5 mL

12

7.85

8.14

0.96

Graph 3:

Analysis 3:

According to graph 3, the optimal value was the pH level of 7. At the pH level of 7, the rate of reaction was the fastest, any pH level higher or lower than that of 7 the enzyme's rate of reaction would decrease. This relationship was

much like that of the temperatures, anything above or below the optimal value the rate of reaction decreases.

## Part 4: Change in Substrate Concentration

Table 4:

Concentration of

H<sub>2</sub>O<sub>2</sub> of Distilled Water

Trial

Time of catalase to travel from the bottom of the test tube to the top (s)

Distance of bottom of test tube to substrate(cm)

Rate of change of the catalyzed reaction (cm/s)

15 mL of H<sub>2</sub>O<sub>2</sub>

3%

1

5.89

8.0

1.36

2

6.86

8. 0

1. 17

Total

6. 38

8. 0

1. 27

13 mL of H<sub>2</sub>O<sub>2</sub> 2. 6%

1

8. 13

8. 0

0. 98

2

7. 11

8. 0

1. 13

Total

7. 62

8. 0

1. 01

10 mL of H2O2 2%

1

8. 65

8. 0

0. 87

2

12. 8

8. 0

0. 63

Total

10. 73

8. 0

0. 75

7. 5 mL of H2O2 1. 5%

1

9.43

8.0

0.84

2

12.53

8.0

0.64

Total

10.98

8.0

0.74

5 mL of H<sub>2</sub>O<sub>2</sub> 1%

1

10.37

8.0

0.77

2

12. 88

8. 0

0. 62

Total

12. 63

8. 0

0. 70

Graph 4:

Analysis 4:

According to graph 4, as the concentration of the substrate (hydrogen peroxide) increases the rate of reaction also increases. This relationship was much like that of the change in enzyme concentration.

## **Part 5: Addition of an Inhibitor**

Table 5:

Experiment Number

Amount of Inhibitor (copper (II) sulfate drops)

Time (s)

Distance (cm)

Rate of change (cm/s)

1

0

4. 13

8. 0

1. 94

2

1

4. 68

8. 0

1. 71

3

5

5. 57

8. 0

1. 44

4

10

6.66

8.0

1.20

5

15

8.57

8.0

0.93

Graph 5:

Analysis 5:

According to graph 5, as there was an increase in the drops of copper (II) sulphate (the inhibitor for this lab) there was a decrease in the rate of reaction. This was due to the fact that the copper (II) sulphate blocked the active site of the catalase.

## **Evaluation: Conclusion**

For each part of the lab, there were hypothesis made in the beginning of the experiments. Each experiment was done and observed and a conclusion was



reached on whether the hypothesis for the experiment made sense and was proven.

### Part 1: Change in Enzyme Concentration

Hypothesis: If there was an increase in the concentration of the catalase, then there would be an increase in the rate of reaction.

This hypothesis was proven to be true. As there was an increase in the concentration of the enzyme, the catalase, there was an increase in the rate of reaction. This was due to the fact that there were more catalase enzymes available for the substrates to bind to and soon react with. The concentration of the substrate was maintained at the naturally available concentration, there were no changes made. That meant that there were more active sites available to the substrates to bind to. The more the active sites there were, the more substrates were being reacted at the same time, therefore decreasing the time it took to fully react with all the substrate molecules.

### Table 2: Change in temperature

Hypothesis: If the temperature of the environment surrounding the reaction increases the rate of reaction will also increase, until it reaches the optimal point, the point at which the rate of reaction will start to decrease.

The hypothesis was proven to be true as well. The rate of reaction did increase until it reached the optimal point. At the optimal point (35°C) the rate of reaction was the highest, which meant the most number of hydrogen peroxide molecules were reacting with the enzymes during the experiment at that specific temperature. In other words, the optimal point was when the <https://assignbuster.com/factors-affecting-the-rate-of-enzymes-activity-biology-essay/>

enzymes worked the best. As the temperature rose, the molecules possessed more kinetic energy. The more kinetic energy there was, the more the molecules moved and collided with one another, increasing the rate of reaction, until it reached the optimal point. Once the temperature started to increase higher than 35°C the catalase started to denature, which meant the shape of the enzyme would start to differ. The denaturing catalase decreased the rate of reaction because there weren't as many healthy normal catalase molecules to maintain the rate or even increase it.

### Part 3: Change in pH Level

Hypothesis: If the pH level of the substrate increased then the rate of reaction will also increase until an optimal pH level is reached. Anything above or below the optimal pH level the enzyme will denature.

This hypothesis was also proven to be true. The optimal pH level was 7, neutral, for the catalase. This meant at pH 7, the most enzyme-substrate reactions were taking place at that specific time. Enzymes work within a small pH range, therefore pH levels tend to have a great impact on the enzyme-substrate activity (Nelson Biology 12). Any pH level above or below 7 started to denature the enzyme, slowing down the rate of reaction. Denaturing enzymes meant that the shape of the overall enzyme had changed. This meant that at the pH levels of 2, 4, 9 or 12 the shape of the active site for the substrate to bond to would change, slowing down the process. At the pH level of 7, catalase's activity was the greatest.

### Part 4: Change in Substrate Concentration

Hypothesis: If the concentration of the substrate (hydrogen peroxide) increases the rate of reaction also increases.

This hypothesis was proven to be true. This relationship was much like that of the concentration of the catalase. As the concentration of the substrate increased the rate of reaction also increased because there were more hydrogen peroxide molecules available to react with the catalase. However, at one point (the point of saturation, which wasn't achieved in this lab) the rate of reaction would be constant. That meant at a given point during the experiment, all of the active sites of the catalase would be occupied with a hydrogen peroxide molecule and the rate of reaction would neither increase nor decrease. Strictly looking at the experiment observed, the rate of reaction was increasing as the substrate concentration was increasing because there were more substrates available to react with an enzyme at a specific time.

#### Part 5: Addition of an Inhibitor

Hypothesis: If the addition of an inhibitor increased then that means the rate of reaction would decrease.

This hypothesis was also proven correct. The copper (II) sulphate acted as an inhibitor for the experiment. When added, the copper (II) sulphate attached itself to the active site of the catalase molecules, causing the rate of reaction to decrease. The copper (II) sulphate was meant to block the active site, which it did successfully, hence the decrease in the rate of reaction. This meant, the more copper (II) sulphate was added the lower the rate of reaction would be. This is because this inhibitor stalls the reaction time  
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because there are less reactions taking place at that moment in time, due to the fact that the active sites are blocked off from the hydrogen peroxide molecules.

### **Evaluation: Sources of Error**

Throughout this lab there were many errors made that were uncontrolled and/or unaccounted for. These errors were not human errors, which were tried to be reduced to the minimal if not none. Some sources of error included: the test tube measurements, errors regarding the filter paper disc and the inconsistent concentration of the catalase.

The test tubes were meant to be all the same shape and hold the same amount. However this was not the case for every single test tube. To the human eyes the amount in the test tube might look the same but in reality the amount might vary. This is due to the fact that the test tubes from the inside do not all have the same shape, after all test tubes are human made and there is a chance of major human error during that process as well. The test tubes not being consistent meant that there was room for error in measurements. Even though the volume of the catalase and the hydrogen peroxide were measured out precisely, the measurements that were made using a ruler were not. This was due to the fact that the test tubes were not all the same, and that the human eye is not precise in analyzing such measurements. This meant there were countless errors throughout the lab.

For many processes the filter paper disc, which was dipped in the potato juice, did not always sink to the bottom of the test tube. Even with the help of forceps and plastic pipettes, which were used to aid the filter paper disc to

the bottom of the test tube, the filter paper disc did not reach the bottom. This was because the catalase that was absorbed into the filter paper disc automatically started reacting with the hydrogen peroxide. They were very inconsistent, some filter paper discs took a longer time to be pushed to the bottom and others simply sank, and since time was a major aspect to the lab this caused many errors.

Catalase concentration was also a source of error. There were many potatoes that were ground and made into potato juice for the purpose of this lab. Naturally, they would carry different concentration of catalase because of the different ways they were grown. There might be a potato that had many nutrients while it was still maturing in the field and a potato that barely got any nutrients. The concentration of the catalase used in one part of the lab would be higher or lower than the concentration of the catalase used in another part because of the different potatoes used. This affected the lab because, like observed before, the higher the concentration of the catalase the higher the rate of reaction there will be. In the future, if only one potato was ground and made into potato juice would help control this aspect of the lab.

These were only three main errors observed during this lab. There were many more, regarding the separate sections of the lab.

### **Evaluation: Next Steps**

Throughout this lab there were many procedures that could have been done differently or to a different point. Another lab could have been carried out with another natural enzyme which could have been comparable to the

factors and affects of catalase. Also, the saturation level was undiscovered for the enzyme (in terms of concentration, and the inhibitors). Both are procedures that could have been carried to obtain a better understanding of enzymes.

**Another miniature lab would have been helpful if done, because then the factors and the affects these factors had on the rate of reactions could have been compared for a better understanding. There is another naturally occurring enzyme that shares characteristics with catalase. This enzyme is called amylase. Amylase is a catalyst that hydrolysis' polysaccharides starch into disaccharide maltose. Amylase can be found in the saliva, produced in the salivary glands and the pancreas. If amylase is added to starch solution, the starch will soon break down to form maltose (Enzyme Lab). Both catalase and amylase are natural occurring enzymes found in the human body and they are great for comparison with one another. If the same lab was done with amylase this lab would help others understand a little more in the similarities and differences between enzymes.**

One other suggestion would be to carry out the experiments to the full potential. After reading and studying enzymes, it is clear that there are saturation points for the substrate concentration and the affects of an inhibitor (Nelson Biology 12). Saturation points refer to the point at which there is no increase or decrease in the rate of reaction between the catalase and hydrogen peroxide. The experiment that required the increase in the substrate concentration could have been (and should have been) carried out until the point of saturation was observed. This is when the rate of reaction stays at a constant because all the active sites are occupied by hydrogen

peroxide molecules and no other reactions can occur. This could have also been possible with the inhibitor part of the lab. At one point no reactions would occur because the inhibitors would have been blocking all the possible active sites for the hydrogen peroxide to react with. This is also referred to as a saturation point. If these saturation points were observed, there would've been a better understanding of the affects the different factors had on the enzyme.

For future labs, both these processes should be considered, if not acted upon. With both processes there is the availability to further the understanding of enzymes and their capabilities in living organisms.

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The innocence in this world has become extinct

Though, my purity still stands because my status is distinct.

I have been refusing to give the green light

Continually declining every invite

It holds all the respect

It's just not enough to relinquish in an hour

Once it is gone, its gone forever

It's just not worth it to me

One of my worst enemies is Regret

All the hurt and all the pain is hard to forget

I don't want to be a statistic

So when it comes to sex, we speak of different linguistics.

I must add that my mind is pessimistic.



What if something goes wrong?

What if it's sadistic

They always ask me if I'm clean.

Give it up baby, you're already seventeen

Sounds like a kid to me

I don't know what the fuck you mean.

I'm just not you, one who lets lust consume

Seems like everyone lost it already

In this I must say,

My standards must be met for it to be given away.

That man better love me to death

I better be the reason for his every breath

Baby don't you see the ring on that right fist

Because I dare that man to run off with my virginity