# Effect of Temperature on enzyme activity

## Aim

To investigate enzyme activity of yeast on glucose at different temperatures

## Hypothesis

As the temperature increases, enzyme activity will also increase. At lower temperatures enzyme activity will be less than when the temperature is higher. Also if temperature is increased too much, enzymatic activity will fall.

This is because the molecules in glucose will move faster and the enzymes will be have increased activity because of increased movement. Also since all enzymes have an optimum temperature at which enzymatic activity is the highest, increasing the temperature will move enzyme closer to optimum temperature. But if temperature is increased too much, enzyme will start to denature (loss of three-dimensional structure) and thus the enzymatic activity will fall again

## Key Variables

**Independent:** Temperature
**Dependent:** Enzymatic activity (number of bubbles)
**Controlled:** Amount of water that the solution is submerged in
Time
Concentration of glucose

## Materials

- · 100mL beakers x5 (label from A-E)
- · 5 $cm^3$ syringes x5
- · 10 $cm^3$ of 10% yeast solution
- · 15$cm^3$ of 2% glucose solution
- · 1 thermometer
- · 2 hotplates
- · Stopwatch
- · Ice cubes x 6
- · 400mL water
- · Observations chart & pen

## Method

1. 1. Place 6 ice cubes and 80 mL of water into Beaker A
2. 2. Measure and record the temperature (should be around 10°C)
3. 3. Fill 3$cm^3$ of glucose solution into the syringe and then in the same syringe insert 2 $cm^3$ of the yeast solution
4. 4. Place the syringe into Beaker A (mouth facing up) and record the number of bubbles produced in 10, 15 and 20 minutes
5. 5. Fill Beaker B will 80 mL of water at room temperature (20°C)
6. 6. Fill 3$cm^3$ of glucose solution into the syringe and then in the same syringe insert 2 $cm^3$ of the yeast solution
7. 7. Place the syringe into Beaker B (mouth facing up) and record the number of bubbles produced in 10,15 and 20 minutes
8. 8. Set up a hotplate at 30°C
9. 9. Fill Beaker C with 80 mL of water and place on hotplate
10. Fill 3$cm^3$ of glucose solution into the syringe and then in the same syringe insert 2 $cm^3$ of the yeast solution
11. Place the syringe into Beaker C and record the number of

bubbles produced in 10,15 and 20 minutes

12.Repeat steps 9-11 for 40°C and 50°C in Beaker D and E

# Data

## Raw Data

| Time | 10°C | 20*C | 30*C | 40*C | 50*C |
|---|---|---|---|---|---|
| 10 | 3 | 7 | 15 | 36 | 18 |
| 15 | 4 | 9 | 20 | 42 | 18 |
| 20 | 6 | 11 | 24 | 45 | 20 |

## Processed Data

| Time (minutes) | Temperature | | | | |
|---|---|---|---|---|---|
| | 10 °C | 20 *C | 30 *C | 40 *C | 50 *C |
| 10 | 3 | 7 | 15 | 36 | 18 |
| 15 | 4 | 9 | 20 | 42 | 18 |

| | | | | | |
|---|---|---|---|---|---|
| 20 | 6 | 11 | 24 | 45 | 20 |

## Data Analysis

From the data above it can be seen that the hypothesis was correct because the enzymatic activity did increase until the optimum temperature of 40°C was reached and started to fall after that point.

## Conclusion

In conclusion my hypothesis was correct because the rate or enzymatic activity did increase to a point and then dropped. This is due to the enzymes having an optimum temperature at which they catalyze reactions most efficiently. It can be seen that the optimum level for enzymatic activity is at 40 degrees Celsius because that is the peak of the curve and any point before or after that point has less enzymatic activity. At high temperatures the molecules, the enzymes and the substrates, move around fastest, and thus there are the most collisions per second, causing enzyme-substrate complexes to be formed more frequently and thus have a higher rate of reaction. Points after the optimum temperature result in a lower rate of reaction because the enzymes start to get denatured and

lose enzyme structure and thus the substrate (e.g. glucose molecules) cannot bind to the active site of enzyme. So the higher the temperature the most enzymatic activity there will be until the optimum temperature and any temperature after that will result in denaturation of enzymes and drop in enzymatic activity.

## Evaluation

| Limitations | Evaluations |
|---|---|
| The intervals between our temperatures was 10 degrees which is relatively inaccurate whereas we could have used a smaller gap between temperatures to gain more accuracy | Next time, I would use 2 degree gaps between my temperatures so I would have a more specific set of data and a smoother curve for the data. |
| The method in which we measured the enzymatic activity was very inaccurate as a result of human error because we manually counted the bubbles as we saw it. This was a very crude and inaccurate way of measuring because there were points were many bubbles came out at once so it was hard to | Since there is not many ways in which this error can be improved, we could use another factor to measure enzymatic activity such as the pH level. |

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|---|---|
| count them all and there were many small ones attached to big ones so a few bubbles might have been counted twice or not counted at all. | |
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