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Enzyme Investigation

Introduction

An enzyme is a biological catalyst that alters the rate of a reaction without being changed itself. Enzymes are three dimensional shape proteins that has a very specific active site. "In enzymatic reactions, substrates are converted into different molecules also known as products. Since enzymes are very selective for their substrates, each enzyme can only convert one kind of substrate into one kind of product molecule. [1]

Research Question

How does the concentration of hydrogen peroxide affect the amount of oxygen produced by the enzyme catalase?

Hypothesis

If catalase is added to the varying levels of dilution of hydrogen peroxide samples, the solution with the highest substrate concentration will yield the most activity, thus producing more oxygen gas. This assumption is based on scientific theory, which states that higher substrate concentrations increase the ability of enzymes to catalyze reactions. [2] As substrate concentration increases, the amount of substrate per unit volume increases. So it is more likely than an en enzyme molecule collides with a substrate molecule, as more successful collisions are more likely to occur. This means enzyme activity increases and the rate of reaction also increases.

Independent and dependent variables

	Variable measured	Method of measuring variable
Independent variable	Hydrogen peroxide concentration (%)	The 5 values I will use for the concentration of substrate hydrogen peroxide would be 20%, 40%, 60%, 80% and 100%. These percentages will be calculated from the hydrogen peroxide to water concentration radio where water is used to dilute the hydrogen peroxide. The concentration percentage/ hydrogen peroxide to water ratio will be as follows: - 4ml: 16ml = 20% - 8ml: 12ml = 40% - 12ml: 8ml = 60% - 16ml: 4ml = 80% - 20ml: 0ml= 100%
Dependent variable	The volume of oxygen produced (cm_3)	The volume of oxygen produced from the reaction between the carrot catalase and the hydrogen peroxide will be collected and measured using a gas syringe.

[1] Smith AL (Ed) (1997). *Oxford dictionary of biochemistry and molecular biology.* Oxford [Oxfordshire]: Oxford University Press

[2] Ward, William, and Alan Damon. "Chaper 3- Chemistry Of Life." *Pearson Baccalaureate: Higher Level (plus Standard Level Options) : Biology Developed Specifically for the Ib Diploma.* Harlow, [England: Pearson Education, 2007. 68-69. Print.

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Controlled variables

	Variable measured	Method of measuring variable
Controlled variables	Amount of catalase	5 potato pieces would be used for each experiment to ensure accurate results.
	Size/SA of potato	Each potato piece would be obtained using a core borer to ensure the diameter of each piece is constant. Each piece will also be 2cm long by using a ruler to measure each one.
	Time	For each experiment, the potato pieces would be left in the hydrogen peroxide to react for 5 minutes after which the volume of oxygen produced would be recorded. A timer would be used to time accurately.
	Volume of solution ($cm^{3)}$	20 cm^3 of solution will be used for each experiment. The concentration however, may vary with the amount of hydrogen peroxide and water as long as the volume totals 20 $cm^{3.}$ Measuring cylinders will be used for accurate measurement.
	Type of substrate & enzyme	The type of substrate and enzyme has to be the same for the whole experiment to work. The substrate is the hydrogen peroxide and the enzyme is catalase, which is obtained from potatoes.
	Equipment	Equipment such as measuring cylinders, conical flasks and gas syringes will need to be the same. This is because different equipment would have different uncertainties, which may affect the final readings of the experiment.

Equipment

- Delivery tube
- Gas syringe
- Stopwatch

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- 5 Conical flasks
- Clamp stand
- Core borer
- Knife
- Tile
- Measuring cylinder
- Ruler
- Potato
- Hydrogen peroxide
- Distilled water
- Bung

Risk Assessment

- Take caution as harmful chemicals will be used (hydrogen peroxide)
- Safety clothing (goggles, lab coat, sensible shoes) should be worn to ensure the protection of skin
- Glass equipment to be handled with care to avoid glass breakage
- Long hair should be tied back

Diagram

Method

1. Cut potato with core borer
2. Cut potato(with knife) into 2cm pieces(measured with a ruler)
3. Put 5 potato pieces into conical flask

4. Set clamp stand up with the gas syringe clamped in and connected through a delivery tube to the conical flask
5. Prepare 5 test tubes and label them: 20%, 40%, 60%, 80%, 100%.
   To prepare these different hydrogen peroxide concentration solutions, use 2 different 20cm^3 measuring cylinder, one for water, and one for the hydrogen peroxide to ensure accuracy.
   The table below shows the amount of hydrogen peroxide and distilled water need to prepare different glucose concentrations.

Amount of glucose (cm^3)	Amount of distilled water (cm^3)	Concentration (%)	Total volume (cm^3)
4	16	20	20
8	12	40	20
12	8	60	20
16	4	80	20
20	0	100	20

6.
7. Add one sample to the conical flask with the potato
8. Quickly secure the conical flask with the delivery tube and bung to secure the that the maximum of oxygen can be produced and into the syringe
9. Time (10mins?)
10. Measure amount of oxygen obtained from gas syringe
11. Repeat with the other samples of hydrogen peroxide
12. Repeat experiment 4 more times