Action of an enzyme essay sample

Problem: What effect will a change in temperature of hydrogen peroxide (C) have on the activity of the enzyme Catalase in potatoes measured by the height of the bubbles created by the reaction in a test tube?

Hypothesis: All enzymes either breakdowns substances andor they put substances together. An enzyme is a protein, folded into a complex three-dimensional shape. The active site is the part of the enzyme that allows it to be a catalyst and where substrates join and react. Anabolic reactions speed up the reactions were large molecules are built up from smaller molecules. This reaction usually needs an input of energy before reaction called the energy of activation. Catabolic reactions speed up the process of breaking down large molecules into smaller molecules. Catalase is a biological catalyst that helps speed up the breakdown of hydrogen peroxide into water and oxygen. Catalase is an enzyme and is the fastest enzyme known. In fact one molecule of Catalase can deal with six million molecules of hydrogen peroxide in 1 minute. The reaction we will be testing is catabolic which also means the reaction will give off some energy. Hydrogen Peroxide is often formed as a product of reactions in cells. It can be poisonous if it builds up, so Catalase has to work quickly so it does not build up to much poisoning the cells and killing them. The exact formula of this breakdown is shown here.

In a catabolic reaction, the enzyme molecule can bind with more molecules of substrate. Each enzyme may multiple times. The Substrate molecule fits into the active site of the enzyme. The active site splits the substrate molecule into smaller molecules. The substrate molecule can now reacts to form the product of two smaller molecules, which exit the active site. Temperature affects the activity of enzymes since an increase temperature

speeds up the movement of substrate molecules, so that when they collide with the enzyme they have more energy and are more likely to bind with the active site speeding up the reaction more.

The enzyme activity increases more with the increase of temperature up to a point. As the enzymes are proteins they will break down at high temperatures as the molecules start to vibrate and they could eventually lose their shape. The enzyme loses its three-dimensional shape and the substrate no longer fits into the active site. The enzyme is denatured. As of this high temperatures reduce enzyme activity. Every enzyme has an Optimum Temperature which is a balance between the two effects of temperature. Denaturalizing is sometimes irreversible, and living cells make great efforts to keep the conditions suitable for the enzymes to work. I. e. The body temperature is at 37C which body enzymes work at best. This is their optimum temperature. As the temperature increases both the enzyme and substrate gain heat, causing them both to move around more, this means that the substrate

makes more successful collisions with the enzymes active site, thus the rate of reaction increases, once the optimum temperature is reached the rate of reaction falls rapidly, as shown on the graph above. (Arefin Khan, 2008) Based on the research above I think the enzymes will work best at 37 C body temperature. The enzymes' optimum temperature and will be able to react best with the substrate molecules as they would be moving about more and colliding more with the enzyme molecule increasing the chance of them reacting called a successful collision. At optimum temperature the Enzymes react quicker. In this experiment it will be a catabolic reaction as the

Catalase enzymes will be breaking down the Hydrogen Peroxide molecules into water and oxygen molecules.

Experimental Design: An experiment where the temperature will be varying to have an effect upon the activity of Catalase in potatoes which will be measured by the height of the oxygen bubbles produced. The measurement will be take form the initial height of the hydrogen peroxide to the highest point of the bubbles on the walls of the test tube. The difference between these two points will be the recorded height of the bubbles of oxygen which later will be analyzed to shown the effect of temperature on the activity of Catalase.

Variables: The manipulated variable is the change in temperature of the hydrogen peroxide measured in C. The responding variable will be the maximum height of the oxygen bubbles produced measured in millimeters. Some controlled variables are the amount of potato used for each test, the surface area of the piece of potato, the initial temperature of the potato, the amount of hydrogen peroxide solution and its concentration, the equipment used for each test, the measurement device and the recorder will all be kept constant.

Materials:

* 500ml bottle of dilute hydrogen peroxide

* One potato

* 6 Test tubes

* One test tube rack

* Test tube clamp

* One roll of tape(heat and water resistant)

* Knifes and cutlery

* Ice

* Cutting tile

* Weighting scale

* Weigh boat

* gloves

* goggles

* lab coat

* water

* ruler

* hot plate

* 6 beakers

* Graduated cylinder

* Thermometer

* Scoopula

* Forceps

Safety: Hydrogen peroxide is a toxic substance so handle with care and caution. Hot plate will be used to heat water, around these areas use caution. There will be a waste disposal breaker provide for solutions after reactions. Don’t pour potato chunks or solution down the sink. Remember to wash equipment before and after each trail.

Procedure:

1. Using a knife and other cutlery, cut 6 identical pieces of potato, and weigh each piece to be sure each of them are identical. Record the average weight of the pieces and the temperature of the potato and any qualitative observations.

2. Measure 5ml of hydrogen peroxide using the granulated cylinder and pour into each of the 6 test tube and place test tubes in the rack. Record the temperature of the hydrogen peroxide as this will be the starting point. Tape the height of the liquid in the test tube with a piece of tape.

3. Prepare water and or ice bath in varying temperature in the 6 different beakers. 0C, 10C, 20C, 30C, 40C, 50C should be the approximate temperatures of the beakers.

4. Place one test tube in each of the water baths. Let it stand for two min.

5. Once desire temperature has been reached, add one of the 6 pieces of potato in each test tube and place back into the bath. Record any observations made.

6. After the reaction seems to be dormant, tape the highest point of the cluster of oxygen bubbles.

7. Measure the height of the bubbles which now will be the difference between the two pieces of tape and record.

* Repeat the experiment until 7 trails have been reached.

Evidence:

Observations: the potato while in the solution was immediately surrounded by tiny white bubbles indicating a formation of a gas. These bubbles rose to surface and formed a kind of white foam that grew from the walls of the test tube. The potato was a golden yellow with a light brown skin.

* The initial temperature of the hydrogen peroxide was 23. 2C.

* The temperature of the potato was 18. 3C.

* Weight of each potato piece was 0. 1g.

Temperature (C +-0. 2C)

Trail 1

Measured Height (mm +-0. 2mm)

Trail 2

Measured Height (mm +-0. 2mm)

Trail 3

Measured Height (mm +-0. 2mm)

0. 3C

3. 1

4. 1

3. 3

10. 4C

3. 7

4. 3

4. 2

Temperature (C +-0. 2C)

Trail 1

Measured Height (mm +-0. 2mm)

Trail 2

Measured Height (mm +-0. 2mm)

Trail 3

Measured Height (mm +-0. 2mm)

23. 2C

4. 2

4. 9

4. 7

34. 3C

4. 9

5. 1

5. 2

38. 1C

5. 1

6. 5

5. 9

47. 2C

5. 5

5. 9

6. 3

There should really have been 7 trails but in limited time, these were the only acquired measurements.

Analysis:

Temperature (C +-0. 2C)

Average

Measured Height (mm +-0. 2mm)

0. 3C

3. 5

10. 4C

4. 1

23. 2C

4. 6

34. 3C

5. 1

38. 1C

5. 8

47. 2C

5. 9

Interpretations: the experiment showed as temperature increase, that the oxygen and probably also water produce, increased shown by the change in the height of the bubbles. Showing that the substrate molecules are moving faster and the rate of the reactions are increasing and also giving more chance of reaction between more substrates and enzymes. They react quicker so the enzyme reacts with many substrate molecules at a faster rate. A major fault in the experiment was the enzyme itself was not getting heat so the heat most likely couldn’t denature the enzyme as it is contain in the cube of potato where it had some insulation from the heat. It would stay likely been in its optimum temperature more inside the potato where it reacted more and more. This is probably the reason why the enzyme still rose in production of oxygen even in temperature above 40C. If the Enzyme was heated past its Optimum Temperature it would denature and the rate of reaction would greatly decrease as the substrate would no longer fit in the active

site. This shows us that the hypothesis and partly the experiment had overlooked an important aspect of trial. The enzyme working best at body temperature and then decreasing after that at a higher temperature as the enzyme denatured. This did not

occur because the enzyme was not heated itself and stayed at a constant temperature. Instead we heated the Substrate molecules instead (hydrogen peroxide) and this showed that with increasing temperatures of the substrate molecule the enzymes reacted quicker.

This occurred because as the substrate molecules were heated they moved around more increasing the chance of them having a successful collision and reacting.

Evaluation: the experiment overlooked the fact the enzyme had never been heat and so it was insulated by the potato itself and probably didn’t denature which is explaining by an increasing result even after 40C. The hypothesis was partially verified but falsified as the enzyme still increasing produced oxygen even after the inferred optimum temperature. In further experiments, the enzyme should be either heat or checked if in fact all the enzymes or the entire piece was in fact the same temperature as the manipulated temperature being tested.

The background information relived on the enzyme being heat but in this experiment it was most likely shielded from the high heat in the cores of the potato samples. The samples of the potatoes were not identical and produced irregular results. Maybe if there was a machine where it could create identical pieces using automation but even if the size and shape were the same we can never be sure if the number of Catalase would be identical. A three digit scale could have been used. The samples could have been used as a liquid by crushing the potatoes or using a blender to ensure uniform samples. The experiment could have use a vacuum to collect the oxygen as the bubbles could have burst releasing oxygen and losing it form the system. The experiment should have been repeated 7 times or trails for accuracy but there was limited time and only individual work.

Synthesis: The heating of the Substrate molecules instead (hydrogen peroxide) and this showed that with increasing temperatures of the substrate molecule the enzymes reacted quicker. This occurred because as the substrate molecules were heated they moved around more increasing the chance of them having a successful collision and reacting with the Catalase.

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