How does Temperature of Water Affect the Rate of Enzyme Amylase in the Hydrolysis of Starch?

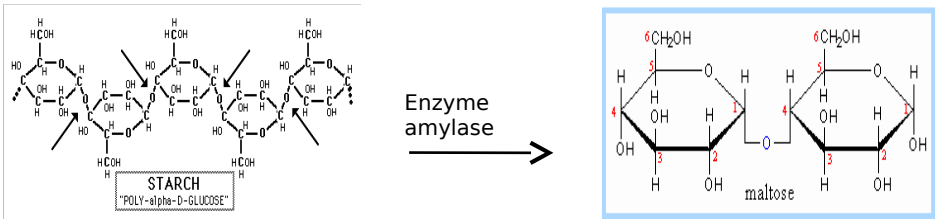
IB Biology Internal Assessment

Research Question

How does temperature of water affect the rate of enzyme amylase in the process of hydrolysis of starch?

Introduction

Amylase is an enzyme found in human saliva and pancreas. It is the digestive enzyme that is needed to hydrolyze starch molecules into maltose molecules.



Amylase must be kept at certain conditions to function at its optimum level. This experiment will explore the effect of temperature on the rate of amylase by using starch and iodine.

Usually iodine has an orange-yellow color, but iodine and starch react to produce a dark blue-black color, so iodine may be used as an indicator to show the rate at which starch has been broken down. Therefore, using this iodine test, the effects of temperature on the rate of amylase can be determined by the time it takes (if at all) for the iodine to turn from dark blue-black into its original orange-yellow color, indicating that starch has been hydrolyzed into maltose.

Hypothesis

Enzymes must be kept at certain conditions to function at its optimum level. Factors may cause the enzyme to denature and lose its function; it includes pH, temperature and salt concentrations. When an enzyme is denatured, it loses its shape and can no longer bind to the active sites of the substrate, and therefore they cannot form the enzyme-substrate complex and carry out its functions. Therefore, increasing temperature of the water in which amylase is reacting in will affect the enzymes function upon the addition of starch, which can be indicated by the iodine test. If the high temperature of the surrounding water denatures the enzyme, the iodine will turn blue-black when starch and enzymes are added because

the enzyme is not able to digest the starch. However, if the temperature of the surrounding is optimum, the iodine will slowly turn orange-yellow because the enzyme had hydrolyzed the starch into maltose.
As the reaction temperature of amylase solution and starch solution increase, the reaction rate of amylase and starch will increase. This will be shown by the lesser time taken for the mixture to turn blue-black into orange-yellow. After reaching the optimal temperature of amylase, the reaction rate of amylase and starch will rapidly decrease as the enzyme will denature and the solution will remain blue-black as the starch will not be hydrolyzed into maltose.

Material List

- 5 test tubes
- 5% Starch solution
- Iodine solution
- Thermostatically controlled water bath at 10°C, 20°C, 40°C, 80°C, 100°C
- Stop watch
- 1% enzyme amylase
- 5 mercury thermometer (uncertainty ± 0.5 °C)
- Droppers

Variables

	Variable Measured	Method of Measuring
Dependent Variable	Rate of starch hydrolysis	• The change in iodine color with the addition of starch and enzyme solution will indicate the hydrolysis of starch. - Iodine turning blue-black indicates the presence of starch, therefore

		enzyme has been denatured - Iodine remains orange-yellow color indicates the absence of starch; therefore starch has been hydrolyzed into maltose.
Independent Variable	Temperature of water surroundings	The mixture will be manipulated by increasing the temperature of the water surrounding. The temperature that will be used are 10°C, 20°C, 40°C, 80°C, 100°C
Controlled Variables		

Procedures

1. Heat the water in a thermostatically controlled water bath for 10°C, 20°C, 40°C, 80°C, 100°C (± 0.5 °C).
2. Pour in 2.0 ml of water with different temperatures in the correspondingly labeled tubes. Check using a thermometer to make sure the water in each test tube is at the exact temperature. Equilibrate the temperature by placing the test tubes inside the corresponding water bath with a test tube rack.
3. Pour the 2.0 ml of iodine solution and 2.0 ml of starch solution into the test tubes.
4. Pour the 1.0 ml of enzyme amylase in one of the test tube.
5. Stir the test tubes with spatula every 30 seconds to evenly distribute the reactants.
6. Measure the time of which the solution turns brown from blue black.
7. Repeat the experiment for the other 4 test tubes and record data.