Catalase Liver Enzyme Lab

Background:
All organisms rely on enzymes to catalyze chemical reactions. An enzyme is a biological catalyst that increases the rate of a chemical reaction by lowering the level of activation energy necessary to start the reaction. Remember, catalysts do not become part of the product. A catalyst can be completely recovered at the end of the reaction. Without enzymes, many chemical reactions that occur within living things would proceed too slowly to be useful. Enzymes speed up these reactions by bringing the reactants into close proximity and facilitating their interaction.

The liver is important for cleaning up potentially dangerous substances that are consumed or produced by metabolic processes. The liver uses specialized enzymes (types of proteins) to help break down toxic substances and make them safe for the body to process. Each enzyme has a particular type of reaction that it can activate; similar to a key only working on one lock.

Catalase is an enzyme in the liver that breaks down hydrogen peroxide. Hydrogen peroxide, the same mild acid that many people use to disinfectant their kitchens or treat cuts and abrasions, is also produced by the body to keep cells healthy. For example, when the immune system is activated in response to bacteria, large amounts of hydrogen peroxide are produced by certain cells to fight the infection. However, if the levels of hydrogen peroxide become too high, the cell's DNA or other proteins can be damaged.

Hydrogen peroxide will decompose into oxygen gas and water on its own, but this reaction takes a long time. It is necessary for the human body to use an enzyme, catalase, to decompose the hydrogen peroxide at a faster rate.

The decomposition reaction is as follows:
$2H_2O_2 \rightarrow 2H_2O + O_2$ <u>or</u> Two molecules of hydrogen peroxide decomposes to produce two molecules of water and one molecule of oxygen gas.

<u>Materials</u>:

Scalpel	**Digital thermometer**	**Hydrogen peroxide**
Tweezers	**Wooden splints**	**Raw beef liver**
Test tube	**Butane lighter**	**Small beaker**
Test tube rack	**Disposal container**	**Pipette**
pH indicator paper		

<u>Procedure</u>:

1. **Use the scalpel to cut a small piece of the raw liver. Scalpels are sharp; use caution. The piece must be small enough to fit in the test tube.**
2. **Observe the liver for color, texture, and odor. Record this on the table.**
3. **Use the digital thermometer to determine the temperature of the liver. Record.**

4. **Wet the inside of the test tube with tap water. This makes getting the liver in the test tube easier.**
5. **Use the tweezers to insert the liver into the test tube. Place the test tube into the test tube rack.**
6. **Use the pipette to drop a few drops of the hydrogen peroxide on a pH indicator strip to determine the approximate pH of the hydrogen peroxide. Record.**
7. **Use the digital thermometer to determine the temperature of the hydrogen peroxide. It should be close to room temperature. Record.**
8. **Use the pipette to transfer a full pipette of hydrogen peroxide to the test tube with the liver. Record all observations.**
9. **Use a glowing wooden splint to carefully test the type of gas produced. Do not allow the glowing splint to touch the liquid. Record findings.**
10. **Use the digital thermometer to test the temperature of the test tube contents. Record.**
11. **Clean up the lab area. Pour the contents of the test tube into the disposal container not the drain! Wash hands before returning to your seat.**

#2 **Color of liver:** **Texture of liver:** **Odor of liver:**
#3 **Temperature of liver in °C**
#6 **Approximate pH of hydrogen peroxide (acid or base)**
#7 **Temperature of hydrogen peroxide in °C**
#8 **Observations after adding hydrogen peroxide to the test tube with the liver**
#9 **Reaction to the glowing wooden splint observations** **Type of gas present**
#10 **Temperature of the liver with the hydrogen peroxide added**

Questions for Analysis

1. **What are enzymes? What are their roles in chemical reactions?**

2. **What was the evidence that a chemical reaction occurred when the hydrogen peroxide was added to the raw liver?**

3. **What specific enzyme breaks down hydrogen peroxide in the human body and why is it necessary?**

4. **Decomposition reactions are usually endothermic. Was the decomposition of hydrogen peroxide endothermic or exothermic? What evidence supports this decision?**

5. **Hydrogen peroxide is often used in the laundry to remove blood. What can you infer is in blood if hydrogen peroxide reacts with it?**

6. **Hydrogen peroxide is stored in a brown bottle that prevents exposure to light. Why do you think this is necessary?**