M G 0005

ENZYMES

Aim

To find out how different surface areas affect the breakdown of hydrogen peroxide.

Plan

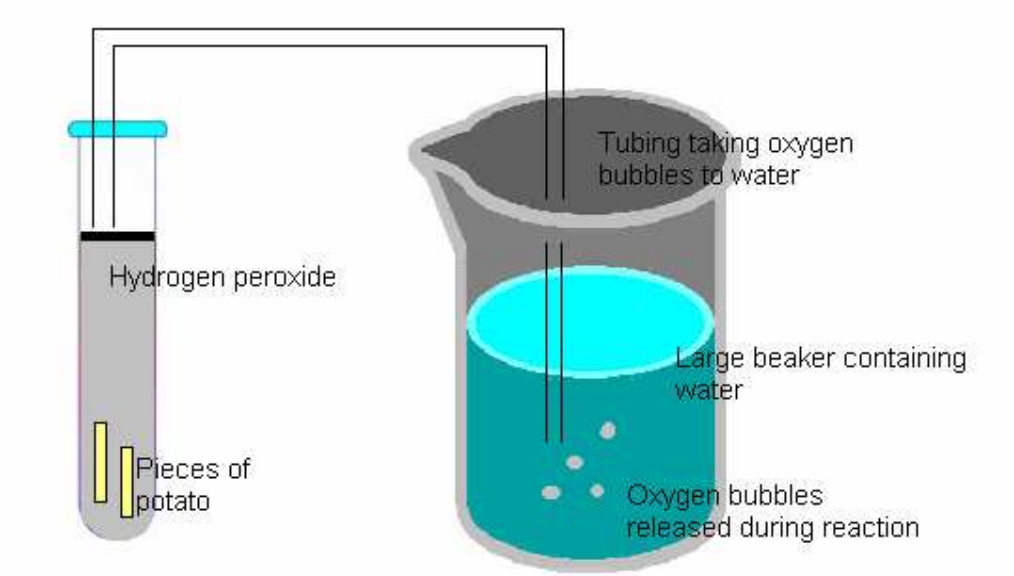
I plan to use potato pieces; cut to 4cm long and for the fist experiment I shall leave it as whole and for the rest of the 4 other experiments I shall divide it up, fist of all divide it into 1/2,1/4, 1/8 and pulp surface areas, and then to place them individually into a beaker of hydrogen peroxide. I will have rubber tubing coming from hydrogen peroxide beaker and the opposite end going into the test tube of water.
When placing the potato pieces into the hydrogen peroxide I shall start the stopwatch and leave the experiment going for 5 minutes and count the number of oxygen bubbles that are produced in the beaker of water within the time, to determine the rates of the different surface areas. I will repeat the experiment again to check my first set of results. To prepare the test I am using a variety of equipment to ensure my work is accurate and valid

Equipment

- 1 beaker
- 1 test tube
- 1 rubber tubing
- Cork borer
- Size 2 pieces of potato
- 20 cm^3 of hydrogen peroxide
- Tub full of Water

- Stop watch

Diagram



Prediction

I predict that changing the surface area of the potato will affect the break down of hydrogen peroxide. I predict as the potato surface area is increased the more oxygen bubbles will be produced; this will happen because as the surface area increase's the surface area of enzymes increases consequently more enzymes to react with the hydrogen peroxide. I think this will happen because an enzyme called catalase breaks down hydrogen peroxide. This enzyme is found in the cells of a potato. When hydrogen peroxide is broken down it forms water, which stays in the cells, and oxygen, which leaves the cells.

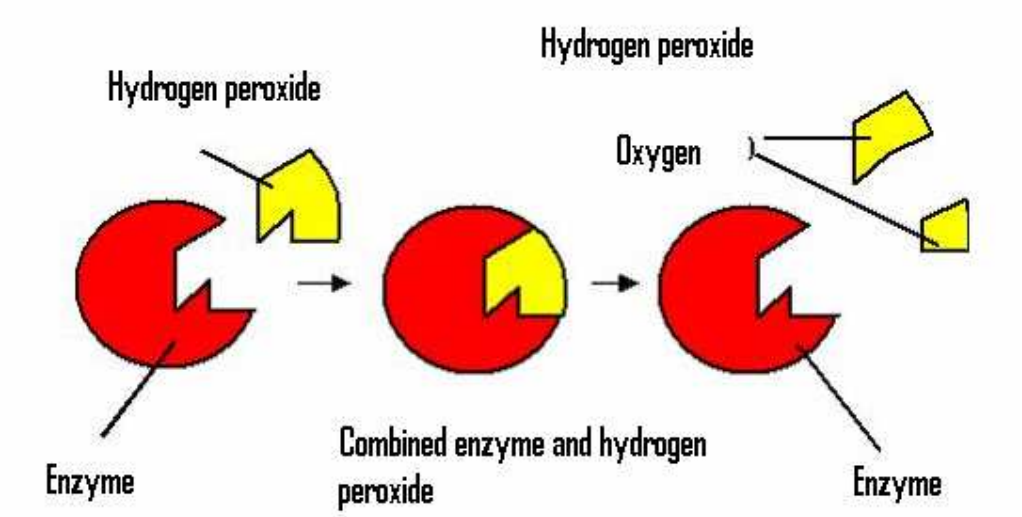
I have predicted this as from my scientific knowledge I know that the more active sites present the faster the rate of reaction will be, as there are likely to be more particle collisions because of the larger surface area. I also predict

that as surface area doubles, in theory, the number of oxygen bubbles produced will also be doubled.

The equation below shows the reaction that takes place when Catalase is added to hydrogen peroxide.

Hydrogen peroxide → water + oxygen

$2H_2O_2 \rightarrow 2H_2O + O_2$



Fair test

To keep this experiment a fair test, I will; I will use the same amount of potato each time, but just cut it up. I will also keep the same amount of hydrogen peroxide. I will also set the stop watch to 5 minutes for each experiment. I will make sure I will use fresh amounts of hydrogen peroxide and potato.

The concentration of hydrogen peroxide: if there is a high concentration, then there is a higher amount of hydrogen peroxide and there will be more collisions. If the concentration is too low, then there is a lower amount of hydrogen peroxide and there will be fewer collisions. If the concentration of hydrogen peroxide is different every time, then this will not be a fair test because there will be different volumes of oxygen will be produced. From my scientific knowledge the more concentrated the solution the

greater the rate of reaction. This is because increasing the concentration means there are more particles of reactant bumping about between the molecules, which make collisions between the important particles more likely. This therefore means increasing the rate of reaction.

Safety

For safety purposes I shall wear safety spectacles throughout the experiment. I will make sure that I take more care when using the knife for cutting the potato, as I could cut myself or even some other person around me. I will also place the knife and experiment on a flat and even surface as if it were to fall; it could cause much danger to people.

Preliminary Tests ***Size of each piece***	***Attempt 1*** ***no. of bubbles &Size of bubbles***	***Attempt 2*** ***no. of bubbles &Size of bubbles***	***Averages*** ***no. of bubbles &Size of bubbles***
1) 4cm	20(3mm diameter)	19(3mm diameter)	19.5 (3mm diameter)

Tests	***Attempt 1*** ***no. of bubbles***	***Attempt 2*** ***no. of bubbles***	***Averages*** ***no. of bubbles***
Size of each piece	***Average Size of bubbles*** (6mm diameter)	***Average Size of bubbles*** (5mm diameter)	***Overall average size of bubbles*** (5.5mm diameter)
1) One piece (4cm long)	22	22	22
2) 1/2 (2pieces 2cm long)	27	28	27.5
3) 1/4 (4Pieces 1cm long)	32	35	33.5
4) 1/8 (8pieces 0.5cm long)	46	42	44
5) Pulp	85	79	82

Analysis

When I added the potato to the hydrogen peroxide, I noticed that after a few seconds that bubbles of oxygen

were being produced from the hydrogen peroxide and potato beaker, to then pass through the rubber tubing, then into the tub of water. I found out that the surface area of a potato does increase the breakdown of hydrogen peroxide. I know this because there is an enzyme that breaks down hydrogen peroxide and this is found on the surface area of the potato. So as the surface area increases, the chance of a hydrogen peroxide molecule being broken down also increases. This happens because, as there are more enzymes, there is a greater chance of a collision. When there are more collisions, more hydrogen peroxide is broken down into water and oxygen. I can see from my results that the amount of bubbles produced went up by a considerable amount as the surface area was increased. The amount of bubbles produced wasn't as much of a steady pattern as I would have guessed, but it is clear that as the potato has been cut up more and more times, the amount of bubbles increases. My results from experiment one varied slightly than from experiment two, as this may be because the hydrogen peroxide I used on the second test was in fact just freshly made up. The hydrogen peroxide has the formula $2H_2O_2$ as the enzymes from the potato mix with this the formula is broken down, it is broken down to just $2H_2O+0_2$, meaning that two of the oxygen atoms have been released. This is the bubbles we saw being released into the water. *(Refer to prediction diagram)*

Evaluation

The bubbles that were released were quite small. Most of them were around 5mm in diameter. It took around 30 seconds before they came through at pace and more frequently. The results that I recorded were fairly accurate. The second test was slightly different, in terms of results. I realised that it was slightly different because I had used a new batch of hydrogen peroxide, which was

more reactive than the last time, but they both show correlation and that as the surface are is increased, so is the number of bubbles produced. To be able to write a firmer conclusion, I could have increased the length of the potato (cut it to 6 cm long) to begin with. This way, the surface area would have increase more than it did so, and the oxygen produced would increase a lot more visibly. Though the potatoes were the same size and length, they were not the same weight and so there must obviously be a better method of obtaining accurate size potatoes. One approach of improving this problem would have been to use a weighing scale that could quite adequately measure to the nearest hundredth, simply for accuracy purposes. By doing this I could have also investigated whether the decomposition reaction taking place in the beakers, would affect the weight or mass of the plant tissue. Another way of measuring the amount of oxygen that is produced is by measuring the amount of foam that has been produce by using a ruler. This method will not be as accurate as the one I have chosen, but will give you the results that are needed.