Biology Essay, Research Paper

Fermentation Investigation

Planning

As a culture of yeast is merged with solution of sugar, a reaction called fermentation occurs. As products, ethanol and carbon dioxide are produced, in form of liquid and gas respectively. The reaction follows this equation:

Glucose solution + Yeast Carbon dioxide + Ethanol + (Energy)

And as one of the products is in the form of gas, the volume of the product can be measured to demonstrate the difference of the reaction when certain factors are changed. In the other words, the rate of reaction can be illustrated by doing appropriate calculation involving the volume of gas produced.

Hypotheses

The factor chosen is the concentration of sugar solution, so the others factors are to be kept constant as control factors in order to make this investigation fair. Here are the control conditions:

\* Sugar used is glucose, because it is a mono saccharine, easy to decompose;

\* Temperature of the environment is 30??C, so that there is enough energy and the enzymes do not denature;

\* The yeast is to come from the same source, being Brewers and Bakers yeast, so they are at the same age.

However, the size of the yeast culture is the factor that cannot be controlled because the yeast samples divided from the initial culture have to be bred in different sugar concentration, which provides different conditions, varying the suitability of reproduction. The next question is how long shall the results be taken for. The initial guideline should be 30 minutes, enough for significant production, with 5 minutes interval for each measurement. However if the rate is too fast and if the meniscus should reach the point where no further reading could be taken, it should end there. The volume of the yeast mixture should also be used in the same quantity throughout the investigation. The considerate quantity is about 2cm3, considering the size of the test tubes themselves. The mixture should be gently shaken to blend the solution and the culture together, as the culture tends to settle at the bottom over a certain time. To make this a fair test, the experiment is to be repeated three times, giving 3 results for each in total, then the average is used and analyzed finally. To save time, several tubes could be set up at the same time, and the measurements could be take simultaneously. Preferably all the experiments of the same set should be started at the same time, as different age of the culture would matter how quickly fermentation occurs.

The most important question is what sugar concentrations should be used, and the concentration chosen are 50%, 100%, 150% and 200%. The 100% solution is made of 3g of sugar, mixed with 100ml of water; 150% is made of 4.5g; 200% of 6g; and 50% of 1.5g respectively.

Planning

Apparatus

The equipment used is:

Method

Label five fermentation tubes 1-5, writing the numbers with a wax pencil upside down near the bottom of each tube. Pipette the following into each tube (10 drops of distilled water, glucose, fructose, pentose, hexose). Set up the fermentation tubes as follows. Hold the filled tube in your hand and insert it into an inverted test tube. With a pencil, or some other suitable instrument, push the small tube into the inverted test tube as far as it will go and then invert the whole assemblage. Tap the outer tube firmly to release any bubbles (CO2) trapped as the mouth of the inner tube. When all fermentation tubes have been set up, record the height of the fluid in mm in each one. Do this by holding the test tube vertically on a table ands placing a millimetre ruler alongside it. Now place all the test tubes in a constant-temperature water bath at 37 0C for at least 45 minutes. Remove the test tubes from the constant-temperature bath, and re-measure the height of the fluid in each fermentation tube. If enough gas has collected in the fermentation tube to make it buoyant, you must push it down when taking your reading. Record the difference in height between the initial and final reading for each of the tubes.

Background knowledge

FERMENTATION is the breakdown of sugars by bacteria and yeast using a method of respiration without oxygen (anaerobic respiration). It involves a culture of yeast and a solution of sugar, producing ethanol and carbon dioxide with the aid of the enzymes. This is an 8-10 step process requiring different enzymes each time, but it can be simplified like this.

This process can be slowed down by DENATURATION of the enzymes at a certain temperature.

All the ENZYMES are protein chains of amino acids. They exist in the form of ?-helix structure with hydrogen bonds holding the pitches together. On the amino acid molecules, there is R a group. They react with each other to form peptide bonds, transforming the chain into a 3-dimensional structure. Along the chain there are active sites where interaction between the enzyme and the substrate happens. These sites are sensitive to heat, like the hydrogen bonds that hold the 3D molecule together. When heat is applied to the enzyme, energy is given into the molecule. The active sites deform and the hydrogen bonds break, denaturing this enzyme. It would not be able to function as usual, and this is not reversible. This is called DENATURATION. The 3D-helix structure would breakdown and the active sites would change in shape; they would not be able to accommodate the substrate any more. The analogy of this is to compare a key to a keyhole. If the keyhole has changed, the same key would not fit in any more, and the lock would not be unlocked. The same thing happens here, and fermentation could not continue after this has occurred. Also when the temperature is too low, the enzymes would not work because there is not enough energy for activities to happen.