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Yeast Investigation

PLAN

Aim:

To determine the effect of temperature upon respiration of Yeast.

Prediction:

I predict that the respiratory rate of the yeast will increase in speed as the temperature of the water increases. However, it may reach a peak, and slowly decline as the temperature increases further.

My reason for the above prediction is that, anyone who has cooked, knows that yeast is supposed to respond in warm water, so I believe that the warmer the water, the more bubbles of CO^2 produced. Also, the oxygen produced in the initial stages of the experiment will allow the speed of reaction, of converting glucose to energy, to increase additionally. It will decrease once all the material has reacted, and/or because the temperature is too high for the yeast to respire as the heat has denatured the yeast's enzymes and they can no longer fit their substrate, and therefore decreasing their capability to work.

Method:

The yeast is put into a glucose solution, this is because the glucose provides the energy for the yeast to respire.

We will take 7 readings of heated water (starting with 10°c), each with a 10°c interval, and observe how many bubbles of CO^2 each temperature allows the yeast, placed in the beaker of water, to produce.
I chose to take 7 readings as 7 is an easy number to work with to obtain and record sensible, clear results. A 10ºc interval allows us to see a broad range of temperatures and therefore, a useful and varied set of results.

Prior to this investigation, we carried out a shorter, irregular experiment of the same kind which produced our preliminary results. This helped as it gave me some indication of what the 'real' experiment would prove and how much/little the variables needed altering.

Precise and reliable evidence will be produced as the suggested method is specific and easy to follow yet will produce a range of results; accurate results will be obtained by repeating the experiment 3 times, as to find any anomalous results, and finding an average of the three results for each temperature.

We should not count the bubbles that appear as the test tube is inserted in to the water as they are just bubbles of air being pushed out, not CO^2 bubbles.

Step by step method:

1. We will have one test tube ($20cm^3$ full) of Yeast suspension in glucose solution.
2. We will then link it via a delivery tube to a another test tube containing normal tap water.
3. We then place the test tube of yeast in a beaker of normal tap water.
4. With a Bunsen burner we will heat the beaker of water, until, measured with a thermometer, the water's temperature reaches 10°c, we then remove the Bunsen burner from underneath the tripod.
5. We then take hold of the test tube of water and turn it upside down, placing it in a container of normal water. At this point we count for one minute the amount of CO^2 bubbles released by the yeast solution into the test tube of normal water.
6. We repeated the process of boiling the beaker of water until the water's temperature reaches 20ºc, 30ºc, 40°c, 50°c, 60°c and finally, 70°c, each time, recording the number of CO^2 bubbles released for one minute.
7. We repeated the experiment as a whole three times as to find any anomalous results and then found the average amount of CO^2 given off (cm^3) from each temperature.

How the experiment will be set up/ apparatus used:

Fair test:

There are several factors that could affect the experiment being fair. The amount of glucose in yeast and water need to be controlled, otherwise the results would not be accurate. The bubbles of CO^2 need to be recorded only for one minute when the temperature is accurate and measured with a thermometer.

Apparatus:

list form: (also see diagram on previous page)

2 Test tubes
Beaker
Heat proof mat
Tripod
Gauze
Bunsen burner
Delivery tube
Clamp stand
Thermometer
Stop watch
Yeast suspension in glucose solution
Tap water
Safety goggles for number of people included in experiment.

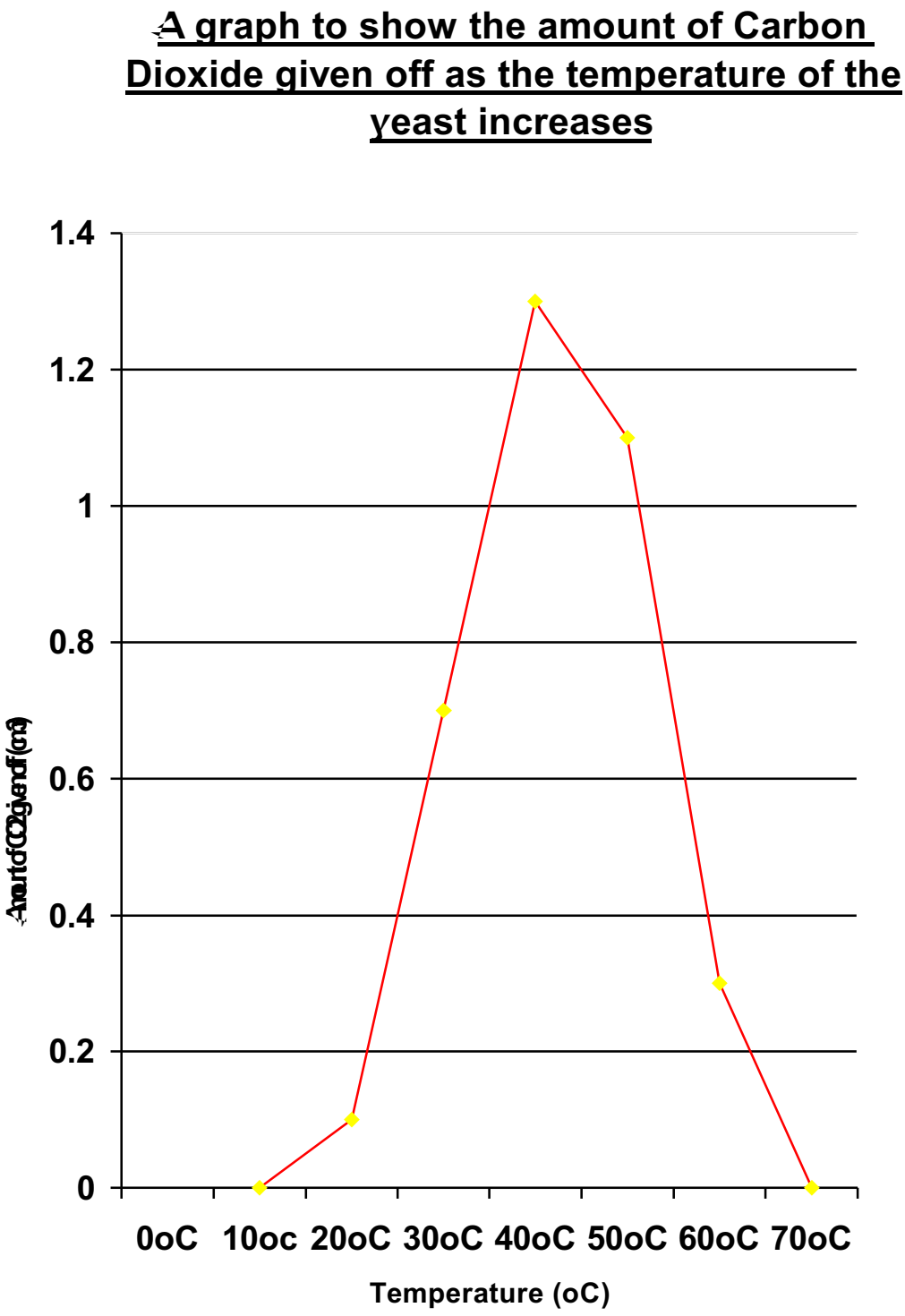
OBTAINING EVIDENCE

Results:

Temp (ºC)	Amount of gas given off (cm^3)			
	1	2	3	Average
10ºC	0.0	0.0	0.0	0
20ºC	0.2	0.1	0.1	0.1
30ºC	0.5	1.0	0.8	0.7
40ºC	1.2	1.4	1.4	1.3
50ºC	1.1	1.0	1.1	1.1
60ºC	0.1	0.4	0.3	0.3
70ºC	0.0	0.0	0.0	0

ANALYSIS & CONCLUSION

Graph:



Conclusion:

We found that the rate of respiration increases gradually as the temperature increases, then, reaching its peak, it declines sharply as all of the material has reacted. If we had continued with the experiment using higher temperatures, we wouldn't have had any CO^2 bubbles being produced.
Between the temperatures of 10ºC and 40ºC, the graph shows that the yeast respires rapidly , producing more CO^2 than between the temperatures of 40ºC and 70ºC, where the level of CO^2 produced decreases.
Therefore, the yeast respires at its best, proved by our results, when the solution of yeast and glucose is at 40ºC.
There is a big difference between the amount of CO^2 produced between 10ºC-20ºC and 20ºC-30ºC. There is a lower rate of reaction for the first process of the experiment, this could be because there is not enough energy given for the enzymes to work as the temperature is too low. The change in the second process of the experiment is caused by the oxygen produced in the initial (first process) stages of the experiment. It allowed the speed of reaction, of converting glucose to energy, to increase as the glucose molecules became more plentiful as the concentration increased, so the probability that the yeast enzymes will come into contact and react with the molecules is higher.
Before 40ºC the rate of reaction increases gradually :- all the enzymes are protein chains of amino acids, along the chains, there are active sites where contact between the enzyme and its substrate take place. These sites are sensitive to heat and its energy. When the enzyme is heated, energy is given into the molecule. As the heat increases, so does the rate of reaction as the molecules are moving, colliding and reacting faster and therefore giving off more CO^2 bubbles.
At 40ºC, the reaction rate reaches its peak. At temperatures above 40ºC:- the amount of CO^2 bubbles decreases, the reaction rate slows down. This is caused by a denatured molecule. A denatured enzyme is when a protein molecule is heated so much that the shape of its substrate has been altered and it cannot fit the enzyme, in order for reaction to take place the enzyme has to fit its substrate molecule so that energy is given. The analogy of this is to compare a key to a keyhole, if the key fits, than an outcome is produced, if the key doesn't fit, no outcome. The same thing happens with enzymes, respiration could not continue for long if the enzymes aren't receiving the energy they need.

Diagram of an enzyme reacting with its substrate:

Diagram of a denatured enzyme:

Our results do agree with my prediction, the results and graph prove that up to a certain temperature, the yeast's rate of respiration increases but as the temperature rises, it destroys the enzyme's shape and as the enzyme can't fit its substrate, it is unable to function properly. However, I predicted that the rate of reaction would decline 'slowly', it did not. The results show a definite and sharp downfall of the respiratory rate once the temperatures exceed 40ºC.

EVALUATING

Accuracy of results:

We didn't have enough time to do the experiment as a whole three times and consequently, we had to borrow another group's results for one third of the whole experiment. The results we obtained ourselves were reliable though, and the group we got our missing results from, we thought were consistent in their way/attitude towards the experiment, and so thought that their results would not differ greatly from our own.
The fact that we used other results from our own, and that those results, in general, agreed with ours, shows that are results are accurate as they are supported and are the same as someone else's experiment. This is also supported by our preliminary results being similar to the ones we obtained whilst doing the experiment.
There are no anomalous results. There are differences between some results of the same temperature, but at the most, only 0.3cm^3.
My explanation of our results in the conclusion, I feel, are correct as I have studied enzymes with their substrates and how they work quite carefully and feel that they are the force and reason behind our results of our experiment. I am confident about my conclusion as my prediction and my graph support what I have explained.

Experimental method:

I feel that the experiment went well and I am satisfied with the results are group have obtained.. We handled the experiment carefully and with detail so that we could be satisfied with what results we would obtain.
Factors that had an affect on the experiment were: doing the whole experiment in several days, the room temperature or apparatus used could have been different and so, not making it a fair test. Also, the percentage of glucose in the yeast affected the experiment because, on different days, there might have been more/less glucose than in the former experiment, which had been performed on a different day. The depth of the test tube in the beaker affected how many bubbles could be released.
To improve this and thus, our results, we should have done the experiment in one day, using the same apparatus throughout. We could have made sure that the test tube was at the same, certain depth in the beaker of water for each experiment and made sure that the solution of yeast and glucose had been properly mixed. Also to check all results, performing the experiment even more times and in better circumstances away from being disturbed would increase the certainty of the results produced.
I think that further research on Yeast and how the experiment should have been performed and carried through in class would have helped me to understand exactly how the experiment worked and what could be obtained from it, hence, making me more confident concerning my attitude towards the experiment and understanding exactly what to do.