Candidate 3 evidence

The effect of different substrates on the rate of respiration

AIM: To investigate the effect of different substrates on the rate of respiration

Underlying biology:

There are three main stages in respiration. These are Glycolysis, The citric acid cycle and the electron transport chain. Glycolysis is a catabolic reaction as it breaks down glucose to form pyruvate. During the first half of the reaction, 2 ATP is used per molecule of glucose. This is called the energy investment phase. In the second half of the reaction, 4 ATP is released creating a net gain of ATP. This is called the energy payoff phase. In the energy payoff phase H ions are released from the substrate. It is a dehydrogenase enzyme that does this. The H+ ions are then given to NAD (a coenzyme molecule) This ends up forming NADH. The NADH then transports the H+ ions over to the electron transport chain. This takes place in the cytoplasm. If oxygen is present, aerobic respiration will continue on to the citric acid cycle. Carbon dioxide and an acetyl group are made by breaking down pyruvate. Every acetyl group bonds with coenzyme A to form acetyl Coenzyme A. Once the acetyl coenzyme A has been made, it combines with oxaloacetate to form citrate. During the cycle more electrons and H+ ions are released. The citrate is eventually gets made back into oxaloacetate and then it will get reused next time. The final stage,

the electron transport chain, is where the NADH from the previous stages have taken the H+ ions and electrons. The electron transport chain contains a group of molecules of protein. The electrons travel along a chain of electron acceptors which releases energy that is needed to pump the hydrogen ions across the membrane. As the return flow of H+ ions crosses through the ATP Synthase, it releases ATP. The electrons then combine with oxygen and H+ ions to form water.

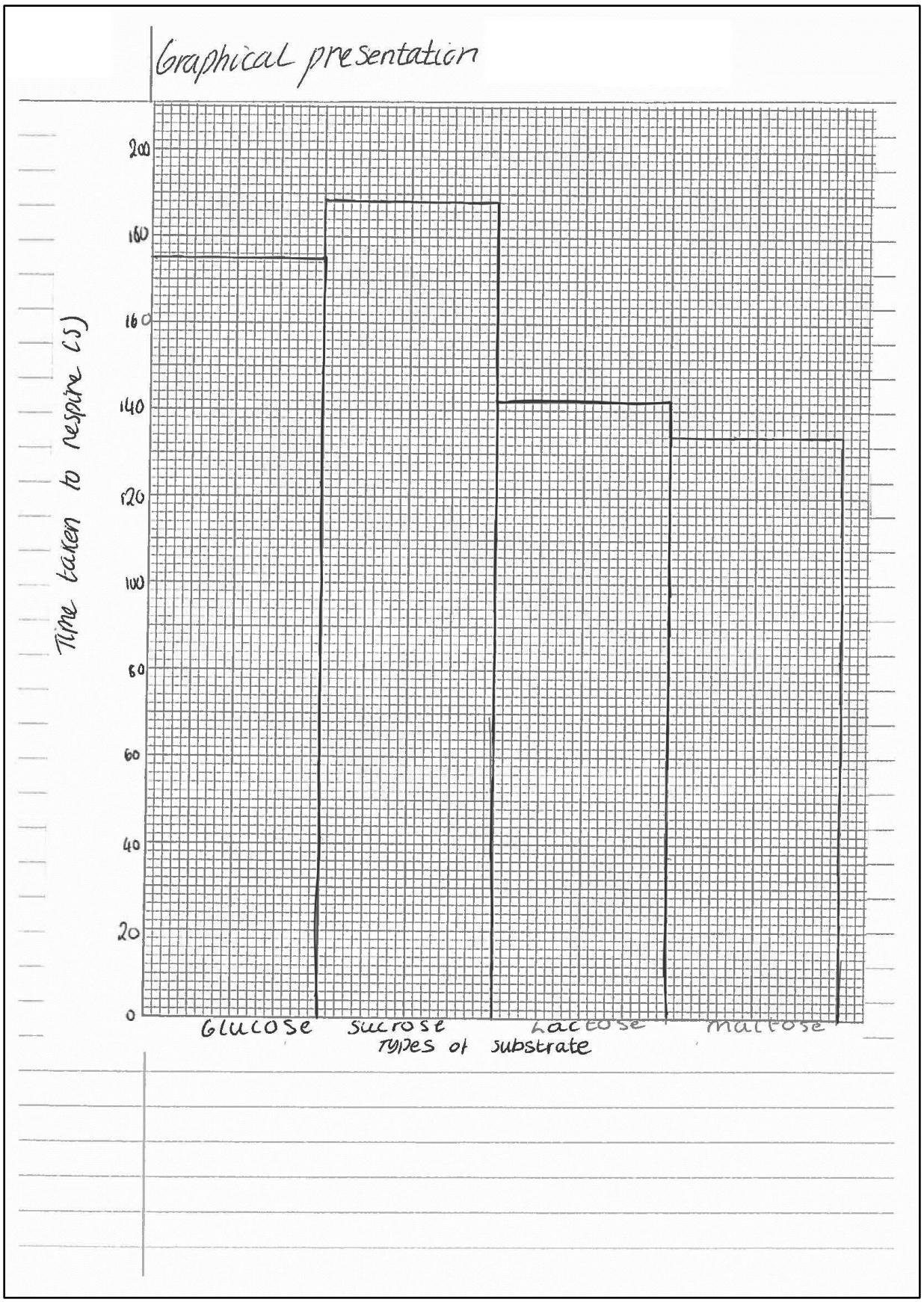
Description of experiment:

I used four different substrates - Glucose, sucrose, Lactose and maltose. We used a syringe to measure out 2ml of yeast and 2ml of one of the substrates and put them into a test tube. I waited five minutes for respiration to occur and the added 2ml of methylene blue to the solution and timed how long it took for the solution to go from blue to the brownish colour. We used a water bath set at 50°C to put the test tube in.

Experimental data !

Different types of substrate	temperature (°C)	Time taken to respire (s) 1	2	3	Average
Glucose	50	230	135	160	175
Sucrose	50	160	270	135	188
lactose	50	180	150	95	142
Maltose	50	180	130	91	134

Sample average calculation: 230 + 135 + 160 = 525 ÷ 3 = 175


Graphical presentation
Time taken to respire (S)
200
180
160
140
120
100
80
60
40
20
0
Glucose
Sucrose
Lactose
Maltose
Types of substrate

Data/information from an internet/literature source:

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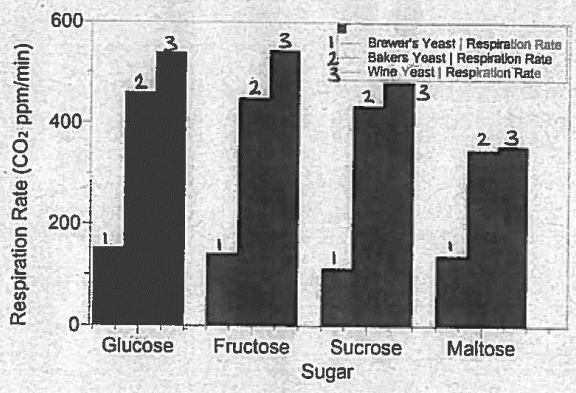
https://www.vernier.com/news/2016/03/23/use-a-co2-gas-sensor-to-study-artifcial-selection-in-yeast/



Accessed on 31st January

Analysis:

In my experiment, maltose was the quickest substrate to respire. My source can back up my experiment because in their experiment, maltose was also the quickest substrate to respire. In my experiment, sucrose was the substrate that respired the slowest. My source can partly back that up as in their experiment, Glucose and sucrose took the same amount of time to respire but they were the slowest in their experiment.

Conclusion:

In conclusion, different substrates have different effects on the rate of respiration. Maltose was the quickest to respire at 136 seconds and Sucrose was the slowest to respire at 188 seconds.

Evaluation:

To make the results more accurate I could have used a ~~colorimeter~~ colorimeter because saying when the methylene blue was completely gone was entirely down to human judgement and was difficult to tell.

- I could have picked a different internet source that did the exact same experiment as me because then I would have been able to make a better comparison and it could have backed up my results better.

- I could have used a better timer that went to a more accurate number like hundredths of a second which would have allowed me to obtain a much more accurate average to analyse and compare to the other source.

Source:
https://www.vernier.com/news/2016/03/23/use-a-co2-gas-sensor-to-study-artificial-selection-in-yeast/

Date accessed: 31/01/19