# Candidate 1 evidence

The effect of glucose concentration on respiration in yeast cells.

Aim: To investigate the effect of glucose concentration on the rate of respiration in yeast cells.

Underlying Biology –

Cellular respiration has 3 stages: glycolysis, citric acid cycle and the electron transport chain.

Stage one of cellular respiration is glycolysis. Glycolysis is the breakdown of glucose into 2 pyruvate molecules. ~~This stage~~ in the cytoplasm. This stage of cellular respiration does not require oxygen. ATP is required for the phosphorylation of glucose and intermediates during the energy investment ~~stage~~ phase of glycolysis. This leads to the generation of more ATP during the energy pay-off stage and results in a net gain of ATP. Dehydrogenase enzymes remove hydrogen ions and electrons from intermediates of this cycle, which are passed to the coenzyme NAD (forming NADH).

Stage two of cellular respiration is the citric acid cycle. The citric acid cycle will only take place if oxygen is present as it is an aerobic process. The pyruvate enters the matrix of the mitochondria and carbon dioxide is removed. The removal of carbon dioxide forms an acetyl group. This acetyl groups forms with coenzyme A to forms acetyl coenzyme A. The acetyl from acetyl coenzyme A binds with oxaloacetate to form citrate. Dehydrogenase enzymes remove hydrogen ions and electrons from intermediates which are passed to coenzymes NAD or FAD (forming NADH or FADH). The high-energy electrons are passed to the electron

transport chain.

Stage 3 of cellular respiration is the electron transport chain. This stage takes place in the inner mitochondrial membrane. The electron transport chain is a collection of proteins on the inner membrane. NADH release the hydrogen ions and electrons to the transport chain. The electrons transfer their energy to the proteins in the membrane providing the energy for hydrogen ions to be pumped across the inner membrane. The flow of the ions back across the membrane synthesises ATP by a protein called ATP synthase. Oxygen is the final hydrogen ion and electron acceptor. The oxygen combines with the hydrogen ions and electrons to form water.

Brief Description

In 5 test tubes, 3ml of resazurin dye, 3ml of yeast solution and 3ml of different glucose concentrations were measured using a syringe and added to each test tube. A water bath was set up at 35°c, which was checked regularly with a thermometer, and the test tubes were placed in the water bath. The decision was made to leave the test tubes in the bath for 50 minutes which was measured using a timer. Once the 50 minutes were up, the test tubes were taken out the water bath and then allocated a colour by using the SSERC colour chart.

A control test tube was set up with 3ml of resazurin dye, 3ml of yeast solution and 3ml of distilled water was added to a test tube so that the 5 other test tubes could be compared to an unreacted solution.

## Results

| Concentration of Glucose (%) | Colour of test tube when compared to SSERC colour chart | | | | |
|---|---|---|---|---|---|
| | Attempt 1 | Attempt 2 | Attempt 3 | Attempt 4 | Average |
| 10% | 6 | 7 | 7 | 6 | 6·5 |
| 20 | 5 | 6 | 5 | 5 | 5·3 |
| 30 | 4 | 5 | 3 | 4 | 4·0 |
| 40 | 3 | 3 | 2 | 2 | 2·3 |
| 50 | 1 | 2 | 1 | 1 | 1·3 |
| control | 10 | 10 | 10 | 10 | 10 |

## Graph

~~One attached~~ See attached

## ~~Literature~~ Literature Source

This experiment was somewhat similar to the experiment carried out here as they allocated the results with a ~~colour~~ number that then gets allocated with a colour from a colour chart. However, they left their solutions in for a shorter time and only went up to 7·5% glucose concentration.

(literature source and link attached)

## Analysis

To analyse the results from this experiment, the percentage decrease is calculated from 10% glucose concentration to 50% glucose concentration.

10% = 6·5 % change = $\frac{\text{Change}}{\text{Original}} \times 100$ Change: $6·5 - 1·3 = 5·2$ $\frac{5·2}{6·5} = 0·8 \times 100$

50% = 1·3 $= 80\%$ decrease

The percentage decrease shows that the solution with 50% glucose concentration was closer to being almost colourless and the 10% solution still had pigment so there is faster respiration rates in the higher percentage solution.

## Conclusion

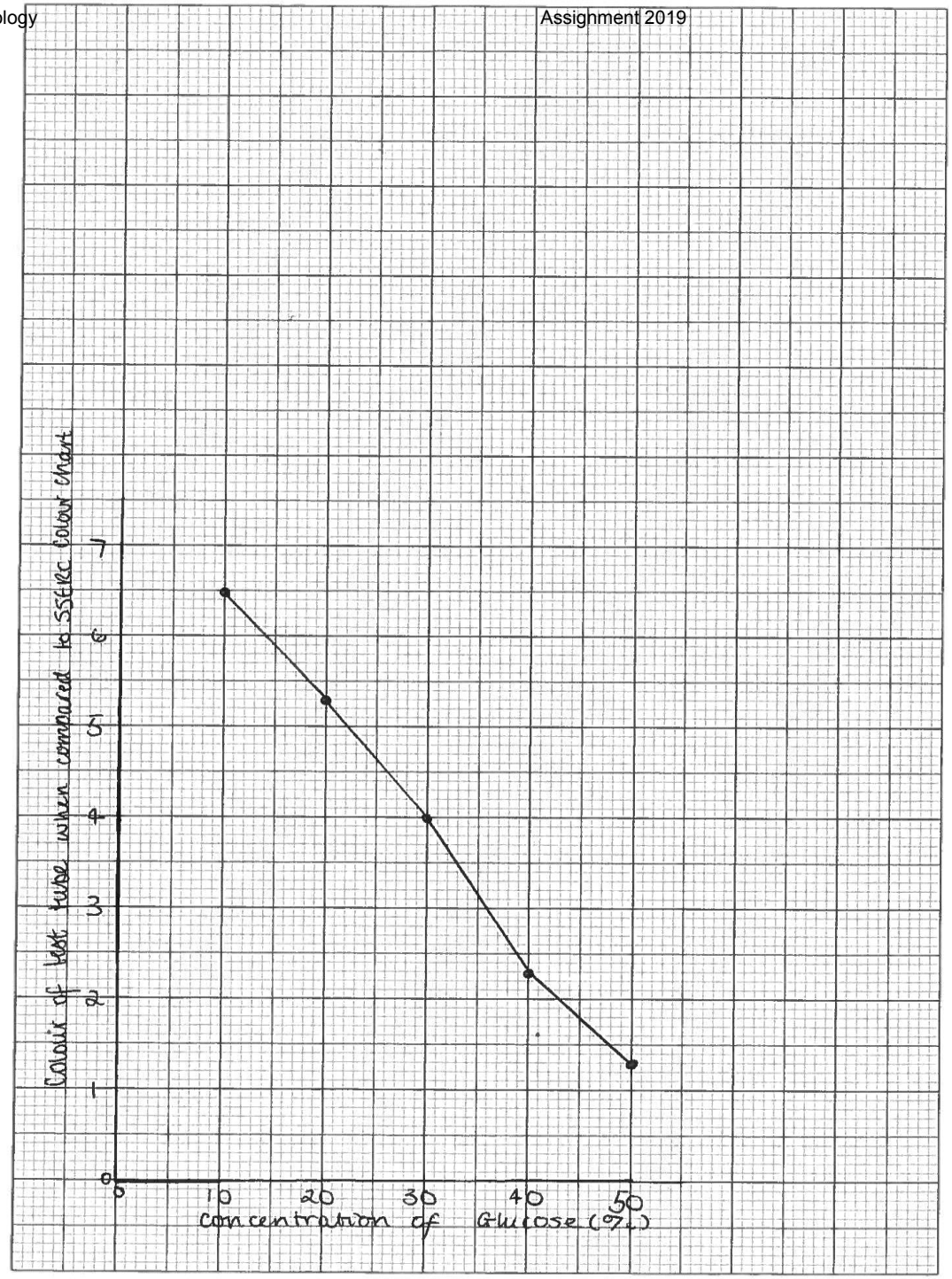
To conclude, the effect of glucose concentration does have an effect on the rate of respiration. This is proved by the experiment that was carried out here as the 10% solution had the darkest colour and the 50% solution had the lightest colour with each concentration in between ~~gradually~~ 50% and 10% ~~getting~~ gradually getting darker. Although the internet source was more proving the longer each solution was left the more colour was lost, it still shows that the higher percentages did often have lower numbers

## Evaluation

The results taken are reliable because the experiment was repeated 4 times so an accurate average could be taken. Another way the results were reliable was because the temperature of the water bath was regularly checked with a thermometer rather than reading the dial on the water bath.

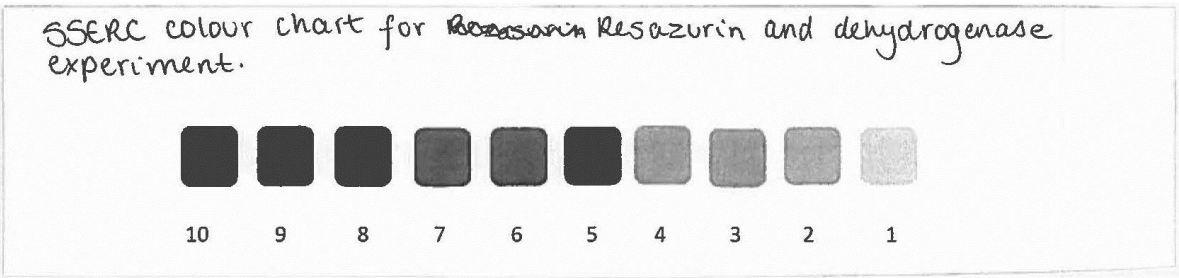
One way to make the results more reliable would be to use a colorimeter instead of using the SSERC colour chart as this would give a more accurate reading of the colours.

There was a common trend between the internet source and the experiment taken place where they both show that if you increase the concentration of glucose, the colour would become lighter. Although the sources could not be compared directly, as they were using different ~~concentration~~ concentrations, they both had similar trends.


Colour of test tube when compared to Benedict colour chart
0
1
2
3
4
5
6
0
10
20
30
40
50
Concentration of Glucose (%)

https://www.sserc.org.uk/subject-areas/biology/higher-human-biology/cellular-respiration/ (last accessed 05/02/19)

| | Effect of glucose concentration on dehydrogenase activity in yeast (decolourisation of resazurin using colour chart) | | | | |
|---|---|---|---|---|---|
| Time (min) | water | 1% glucose soln | 2.5% glucose soln | 5% glucose soln | 7.5% glucose soln |
| 0 | 9 | 9 | 9 | 9 | 9 |
| 3 | 9 | 9 | 9 | 9 | 9 |
| 6 | 9 | 9 | 9 | 7 | 7 |
| 9 | 8 | 7 | 7 | 6 | 6 |
| 12 | 7 | 6 | 6 | 5 | 5 |
| 15 | 5 | 6 | 3 | 3 | 3 |
| 18 | 5 | 2 | 2 | 2 | 2 |
| 21 | 3 | 2 | 2 | 2 | 2 |
| 24 | 3 | 2 | 2 | 2 | 2 |
| 27 | 3 | 1 | 1 | 1 | 1 |
| 30 | 3 | 1 | 1 | 1 | 1 |


SSERC colour chart for Resazurin and dehydrogenase experiment.
10
9
8
7
6
5
4
3
2
1