Yeast fermentation experiment

Design:

Question: how does the yeast concentration affect the rate of anaerobic respiration?? Measured by the concentration of released CO_2.

Main goal (aim): tracking the relationship between the rate of anaerobic respiration and the yeast concentration.

Hypothesis:

Two types of cell respiration exist, aerobic and anaerobic respiration; anaerobic respiration takes place when there is no enough oxygen for the aerobic respiration, the following equation shows the aerobic respiration:

$$\text{Glucose} \xrightarrow{\text{yeast}} \text{Ethanol} + CO_2 + \text{heat}.$$

It is obvious by the previous chemical reaction that as the yeast concentration increases, so does the anaerobic respiration.

Variables:

Independent variable: yeast concentration (a variety of yeast solutions are used, in order to determine the effect of changing yeast concentration on respiration rate).

Dependent variable: CO_2 (released amounts), representing the rate of respiration.

Controlled variables:

Variable	Why to control	How to control
Concentration of sucrose	Because sucrose is the reactions substrate.	It will be kept constant for all the trials.
Temperature	Higher temperature increases the rate of reaction	The experiment will be initiated in room temperature away from air sources.
Time	_____	2 minutes for each trial

Equipments and procedure:

Equipments:

- PASCO GLX with (CO_2 sensor).
- 200 ml, 3 % sucrose solution.
- Variety of yeast solutions (g/ml) (2%,4%,6%,8% and 10%).
- Cylinder.
- Beaker (200 ml).
- Plastic cover.

Procedure:

- Prepare at least 5 different concentrations of yeast (2%, 4%, 6%, 8% and 10%)
- Solutions were prepared by mixing different percentages of yeast with water, one hour before initiating the experiment.
- Prepare 3% sucrose solution.
- Place 3% sucrose solution in the beaker.
- Start by adding 10 ml of 2% yeast suspension, inside the beaker containing sucrose, after shaking the solution (it is better to start by least yeast concentrations then most).
- Place CO_2 sensor inside the beaker (as shown in the apparatus).
- Put the cover on the beakers opening (preferably fast),and wait for the one minute interval (while shaking the solution, when GLX is taking the reading).
  Record the reading after the time has ended (the CO_2 censor was calibrated at the beginning and the data collection settings was modified to collect CO2 concentration in ppm for 1 minute intervals.)
- Empty the beaker and clean it, before repeating the previous procedure.

- Repeat the same procedure for every concentration, 3 times for every single concentration and then obtain the average.
- Record the results in a proper table.
- Represent results in an explanatory graph.

Data collection and processing:

Raw data:

Table (1): initial and final readings of CO_2 evolved for every yeast concentration

Concentration of yeast in solution (gm/ml)	Trial (1)		Trial (2)		Trial (3)	
	Initial CO_2 reading (±50 ppm)	Final CO_2 reading (±50 ppm)	Initial CO_2 reading (±50 ppm)	Final CO_2 reading (±50 ppm)	Initial CO_2 reading (±50 ppm)	Final CO_2 reading (±50 ppm)
2%	5599	13429	7246	18353	7473	19825
4%	9637	26400	7772	22746	6949	28032
6%	8612	37908	7030	36996	7352	32248
8%	7087	37275	6860	41413	7979	39708
10%	7814	58733	7347	44040	8208	57709

Processed data:

1- The average difference was calculated by the following equation:

$$Average\ diff. = \frac{1st\ diff + 2nd\ diff + 3rd\ diff}{3}$$

2- The difference between the final and initial weights was calculated by:

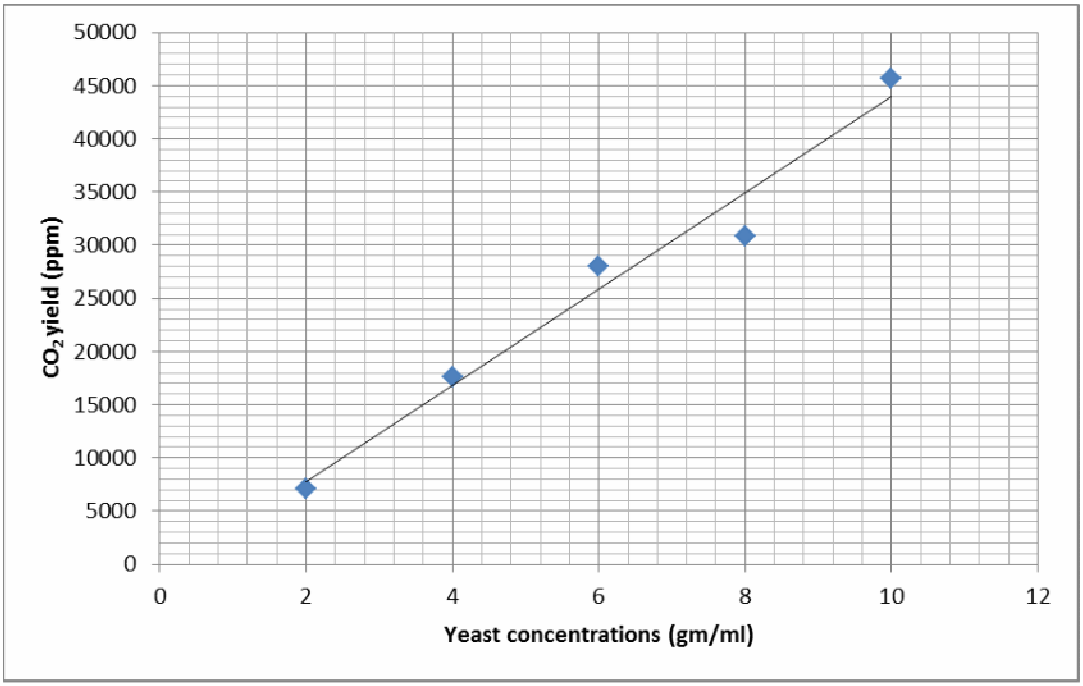
$$Difference = final\ diff. - Initial\ diff.$$

3- The ppm uncertainty , was given by the GLX company or provider.

Table (2): the difference between the initial and final readings CO_2 evolved for every yeast concentration

Concentration of yeast in solution (gm/ml)	Difference between Final and initial CO_2 readings for the three trials (ppm) (±50 ppm)			Average difference (ppm)
	Trial (1)	Trial (2)	Trial (3)	
2%	7830	11107	12352	7096.33
4%	16763	14974	21083	17606.66
6%	29296	29966	24896	28052.66
8%	30188	34553	27729	30823.33
10%	50919	36693	49421	45677.66

The previous data can be represented by the following graph:



Graph (1): the CO_2 yield vs. the yeast concentrations

Conclusion and evaluation:

Conclusion:

1. From the previous tables and graph, the results show that, as yeast concentration increases, which means that the anaerobic respiration rate increases, and thus the hypothesis is proved right.

Evaluation:

1. A problem was faced in taking volumes, since cylinders were the instrument used, which is a way of error.
2. The cover provided didn't it the opening of the cylinder, thus producing errors.
3. Shaking the solution while reading, differed in the intensity, form one solution to the other.

Possible improvements:

1. Use more accurate equipment (pipettes and burettes…. Etc) to take the volumes of yeasts and sucrose.
2. Use an automated machine that does vibration, to make the whole intensity of shaking equal.
3. Use containers or cylinders, which have proper openings for the CO_2 sensor, to get more accurate results.
4. Use another apparatus, where the sucrose will be put into a syringe, the syringe attached to a tube, which goes through the test tube, where the yeast will be put, and the tube contains a proper opening for the CO_2 reader, and then when everything is set up sucrose will be pumped by the syringe and the reaction would start.