Name _____

Date _____ Hour____

Fermentation Lab

Background:

We have learned that ATP is the energy currency of life. All living things require ATP to provide chemical energy to power cellular activities. We learned last week that in anaerobic conditions (absence of oxygen) muscle cells and certain bacteria can still utilize the process of glycolysis to generate NAD^+ and ATP to function (even though aerobic conditions provide for the production of more ATP than fermentation). In fermentation, sugar is broken down into either ethanol or lactic acid, and CO_2.

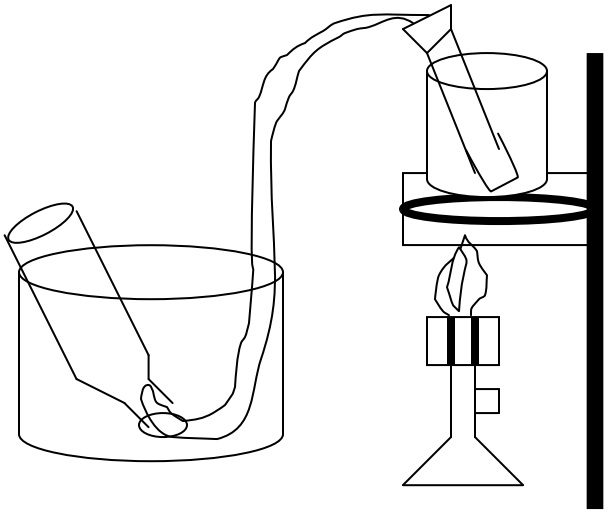
Depending on the concentration of the sugar, temperature, or amount of cells involved, fermentation can happen at different rates. In this investigation we will be changing only the types of sweetener **(sucrose, dextrose, fructose, saccharin, aspartame, or sucralose**) to determine which sweetener yields the great amount of fermentation occurs by measuring the CO_2 production.

Problem: Which sweetener will cause the greatest amount of fermentation to occur?

Hypothesis: _____

_____

Materials: 1 test tube, empty pop bottle, large beaker (250 or 500 ml), 1-holed rubber stopper w/ bent glass tube, rubber hose, thermometer, 20ml of each 12% sugar solutions (fructose, sucrose, aspartame, sucralose, dextrose, saccharin), ring stand w/ heating setup (wire gauze & support ring), bucket, bunsen burner, striker, yeast, graduated cylinder.



Procedure:

My assigned sweetener is _____

Set up apparatus as pictured above:

1. Set up the heating apparatus picture above w/ ring stand, support ring and wire gauze. Light a Bunsen burner and create a 2 inch flame with a bight blue cone in the center. Create a hot water bath for your reaction test tube by filling a large beaker about 1/2 full with tap water and placing onto the heating apparatus.
2. Lower the wire gauze and support ring until it touches the top of the blue cone.
3. Heat the hot water bath until it reaches **32°C** and ***maintain this temp throughout the lab.***

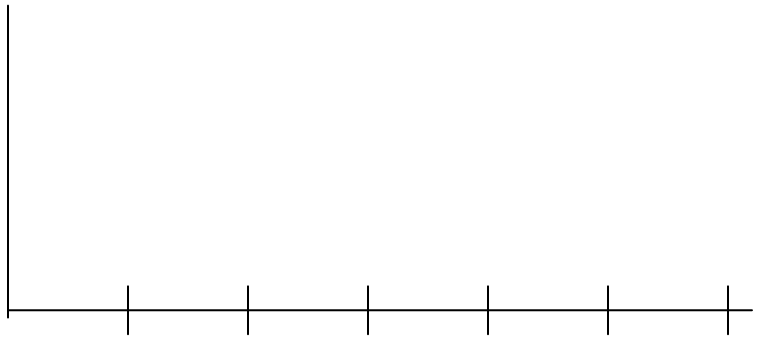
4. Attach a bent glass tube w/a #3 rubber stopper to a rubber hose.
5. Fill a bucket about ½ full with water and invert a completely filled pop bottle into the bucket. *MAKE SURE THERE ARE NO AIR BUBBLES IN IT.*
6. Feed the end of the rubber hose into the water and up into test tube opening (we will collect CO_2 in this test tube).
7. Using a weighing paper, measure out 2.5g of yeast on an electronic balance. Carefully bring back to your table.
8. Place 20 ml of your assigned 12% sweeter solution assigned to your group into the other test tube.
9. Once the bath water is **32°C**: add the 2.5g of yeast into the test tube and shake it up to mix the contents. Place the rubber stopper w/bent glass tube onto to top of the test tube tightly and replace the test tube into the hot water bath.
10. Over a period of 20 minutes, maintain the temperature of the hot water bath @ **32°C** and shake the test tube in the water bath occasionally to release CO_2 into the collection test tube. Record the start and end time for lab to keep track of the lab.
11. After 20 minutes of heating, make one last shake of the reaction test tube from the hot water bath and carefully remove the hose from the bottom of the collection tube.
12. Carefully and swiftly re-vert the collection test tube upright with the mouth of the test tube in your palm to keep all remaining water in the test tube.
13. Pour any remaining water from the collection test tube into a graduated cylinder to determine the amount of water left – **record in table 1 below**.
14. Determine the **volume of gas produced** by **subtracting the final volume from the total volume**.
15. Clean up all supplies, especially the glassware with soap and water.

Data:

Table 1

Sweetener type	Start time	End time (20 minutes later)	Total volume of pop bottle (ml)	Volume of water remaining in pop bottle (ml)	Volume of CO_2 produced in reaction (ml)
Fructose			626 ml		
Sucrose			626 ml		
Aspartame			626 ml		
Sucralose			626 ml		
Dextrose			626 ml		
Saccharin			626 ml		

Graph – *make a bar graph below to demonstrate the production of CO_2 by each sweetener*



Create a 4-part conclusion

Conclusion:

Questions:

1. Why did we control the temperature (32° C) of the yeast and sweetener mixture?

2. Why did we control the concentration of the sweeteners (all were 12% solutions)?

3. List the 6 sweeteners in order of CO_2 production (from least to greatest).

4. Why do we assume that fermentation occurred greater in those test tubes with higher production of CO_2?

5. Why is it that larger sugar molecules generate greater amounts of CO_2 from fermentation?

6. If this reaction took place with aerobic organisms (instead of yeast) in the presence of oxygen, how would the results be different than in our experiment?