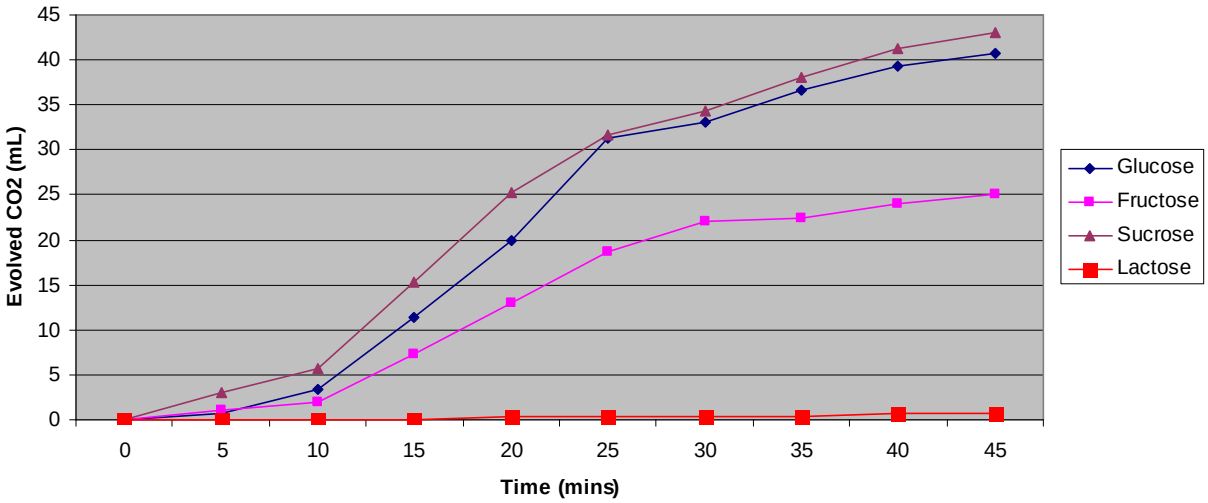
Alcoholic Fermentation of Biological Sugars

Summary: My group and I tested the potentials of four different biological sugars to ferment yeast. We accomplished this by mixing individual samples of glucose, fructose, sucrose and lactose with a yeast solution, and then measuring and comparing the different amounts of evolved CO_2 for each. Our results showed that the disaccharide sucrose is the strongest of the four in reacting with yeast, with glucose also proving to be nearly as effective. This is consistent with popular fermentation techniques that commonly utilize both sucrose and glucose, such as brewing beer *(Brányik et al., 2005)*. Sucrose is also known to be used in the baking of bread, where it increases the nutritional and technological properties of the dough *(Schwab et al., 2008)*.

Methods & Results: For each of our biological sugar samples, my group and I created four separate respirometers out of one small test tube and one slightly larger test tube. We added 5mL of yeast solution to each of the small test tubes and then combined enough of a single sugar solution to fill it completely to the top. Glucose, fructose, sucrose and lactose were combined with yeast solution in test tubes A, B, C and D, respectively. To complete each respirometer, we placed one large test tube over each of the small test tubes so that they would become covered and closed. In doing this, we ensured that firm contact was made between the glass of both the large and small test tubes. We then quickly inverted the combined test tubes so that the mixture was trapped by the bottom of the large test tube. This configuration prevented evolved CO_2 gas from escaping the smaller test tube over the course of the experiment.

We placed all four respirometers into a ~37°C water bath and left them to react. Measurements of CO_2 gas were made at five minute intervals over 45 minutes, which produced the following graph of data:



Our data shows that sucrose is clearly the most effective sugar for yeast fermentation, producing 43mL of CO_2. Glucose reacted very strongly as well, producing 40.67mL. Fructose proved that it is also a fermenting sugar with 25mL CO_2 produced, but is not nearly as strong as either sucrose or glucose. Lactose proved to be quite nonreactive with yeast, yielding only 0.66mL CO_2 over the entire 45 minute time period of the experiment. For lactose, the very low rate of fermentation is due to the absence of lactase, a necessary enzyme to effectively break down lactose sugars.

References:

Brányik, T. & Vicente, A. & Dostálek, P. & Teixeira, J., 2005. Continuous Beer Fermentation Using Immobilized Yeast Cell Bioreactor Systems, *Biotechnology Progress*, 21, pp. 653-663.

Schwab, C. & Mastrengelo, M. & Corsetti, A. & Gänzle, M., 2008. Formation of Oligosaccharides and Polysaccharides by Lactobacillus reuteri LTH5448 and Weissella cibaria 10M in Sorghum Sourdoughs, *Cereal Chemistry*, 85(5), pp. 679-684.