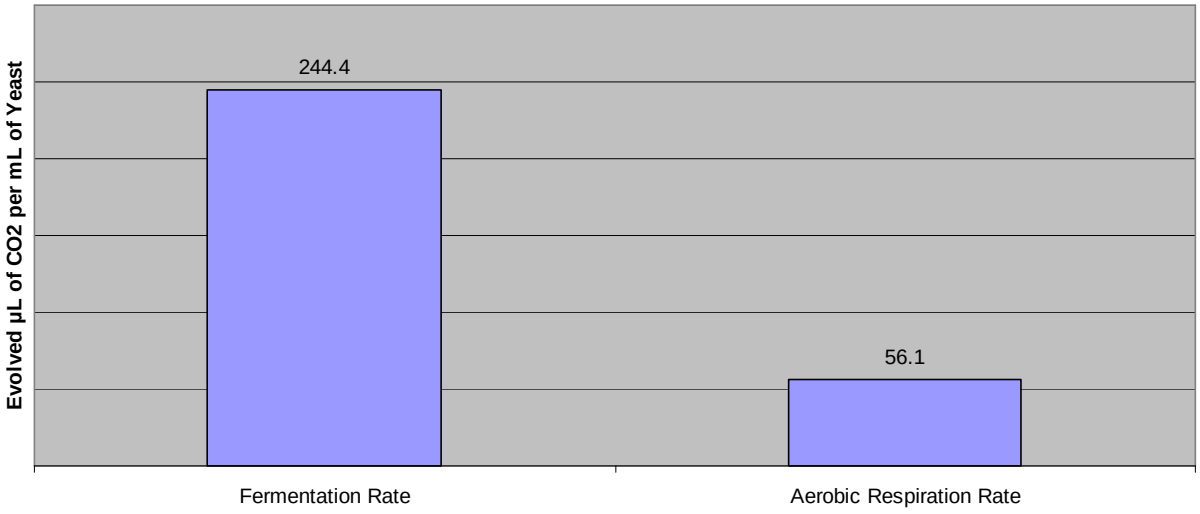
Aerobic Respiration of Yeast

Summary: My group and I tested the amount of oxygen gas consumed during respiration: when the pyruvate product of a reacted sugar molecule combines with oxygen gas (O_2) to form carbon dioxide (CO_2), water (H_2O) and ATP. We did this by fermenting yeast with glucose inside of a Gilson Respirometer, which measured the total amount of oxygen used in the reaction by the change in overall pressure. We combined our data with the data obtained from other groups in the class performing the same experiment. After comparing these results to observations made during the previous experiment *Alcoholic Fermentation of Biological Sugars,* we found that the rate of yeast activity was many magnitudes greater during aerobic respiration, indicating significantly heightened energy production.

Methods & Results: My group and I used a special Gilson Respirometer flask to contain the fermentation reaction. Using a pipette, we first added enough 6M KOH to fill the small separate well in the center of the flask so that it would be about ¾ full, which exists to absorb any produced CO_2 gas and cause a decrease in pressure within a close chamber. A small piece of filter paper about 2cm by 2cm was folded into a fan shape, placed in the center well and then adjusted to protrude a small distance over the edges. We added ~2.5mL of 5% glucose solution and ~0.5mL of 10% yeast solution into the main part of the flask, initiating the fermentation process. The flask was quickly connected to the Gilson Respirometer and submerged into the 35°C water bath. We took measurements at five minute intervals for 15 minutes total.

Readings showed that the change in gas pressure was -128µL after 5 minutes, -198µL after 10 minutes and -253µL after 15 minutes, which indicated the amount of O_2 used. Using this data, we calculated an average rate of consumption of ~16.86µL/min. Data was then shared between groups in the class and a new overall average rate of ~9.35µL/min was determined. We then made comparisons between these results and the data from the previous experiment *Alcoholic Fermentation of Biological Sugars*, expecting a number of differences. We knew that the reaction would be different because of the Pasteur Effect: in aerobic conditions pyruvate is converted into acetyl CoA and a large amount of ATP, yeast cell growth increases and the fermentation rate slows or stops. To measure the "productivities" of the yeast under both conditions, the following graph of data was produced by calculating the amount of gas consumed, or produced, per mL of yeast present (this data represents a direct comparison of relative yield, which allows the original dimensions of the gases from both experiments to be omitted):



The results clearly show that the activity of the yeast during aerobic respiration is incredibly higher than fermentation. In both cases, yeast activity serves as an effective indicator for the amount of energy being produced. While there are certainly many unique chemical properties attributable to both processes, my group and I expect that the immediate use of CO_2 products following aerobic respiration allows the reaction to always move forward at a very high rate (equilibrium cannot be attained). This would serve to explain why there is such a tremendous difference in yeast activity.