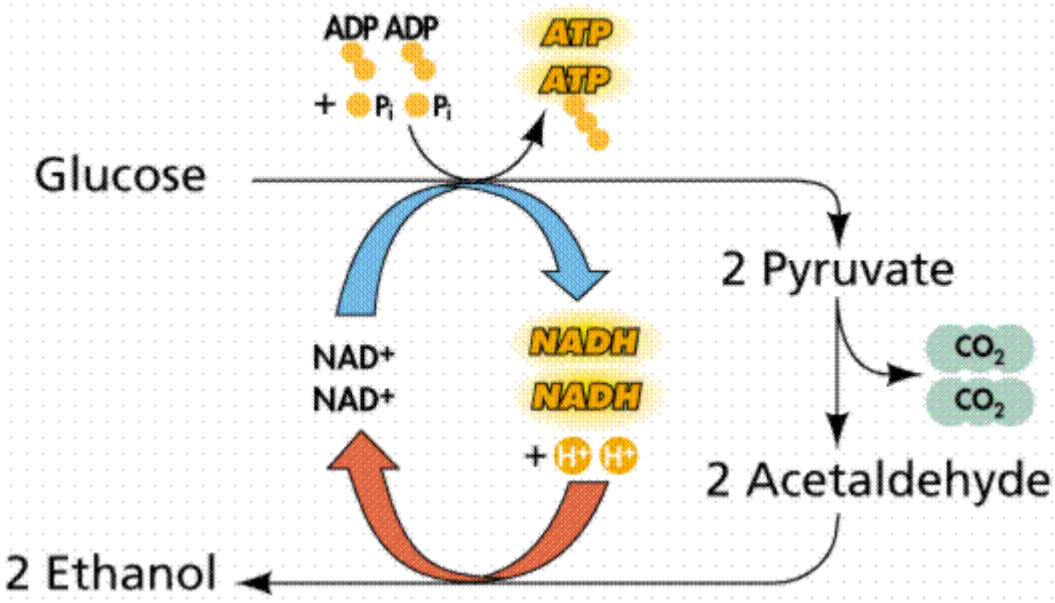
Yeast Fermentation – Anaerobic Cellular Respiration Pathway

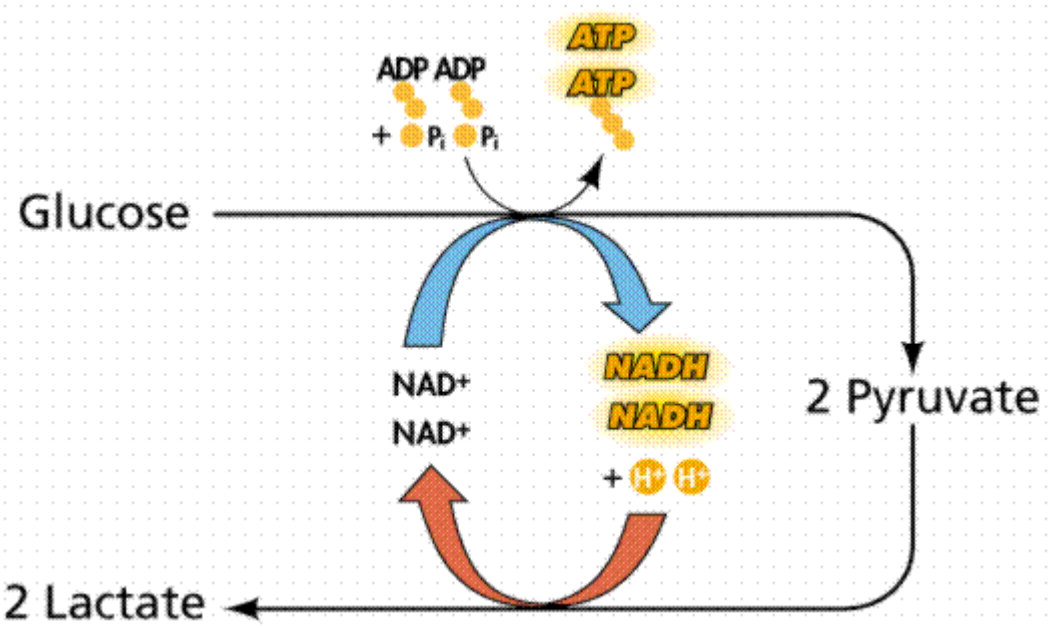
Introduction:

Under anaerobic conditions, the absence of oxygen, pyruvic acid (pyruvate) can be used by the organism in one of three pathways: lactic acid fermentation, alcohol fermentation, or cellular (anaerobic) respiration. Humans cannot ferment alcohol in their own bodies.



Alcohol fermentation is the formation of alcohol from sugar. Yeast, when under anaerobic conditions, convert glucose to pyruvic acid via the glycolysis pathways, then go one step farther, converting pyruvic acid into ethanol, a C-2 compound.

Many organisms will also ferment pyruvic acid into, other chemicals, such as lactic acid. Humans ferment lactic acid in muscles where oxygen becomes depleted, resulting in localized anaerobic conditions. Lactic acid can be converted into ATP via the normal aerobic respiration pathways.



Basic Materials per group per run

- 30 g dried, active yeast (Fleischmann's Yeast)
- 250 mL tap water (minerals are needed by living things!)
- 500 mL plastic screw cap bottle
- 100 mL beaker
- 250 mL Erlenmeyer flask
- 100 mL graduated cylinder
- 500 mL graduated cylinder
- 1-holed stopper for the above flask (#6)

- a collection of substrates such as sucrose (table sugar), glucose, fructose, galactose, Sweet'n'Low®, Splenda®, Equal®

Preparing Your Yeast Culture

1. Make a culture of yeast with room temperature tap-water. This is to be used in all trials.
2. Measure out 150 mL of the water and pour it into the 500 mL screw cap plastic bottle.
3. Weigh out 30 g of the dried yeast and add it to the beaker and swirl until suspension is homogeneous.
4. This is now your "source culture"

Preparing Your Equipment

5. Cautions:
    a. You should count the number of bubbles in each of at least three separate minutes. The reaction might be speeding up, and, if so, the later minutes will have higher counts. Record the average of the higher counts.
    b. Wait at least 3 - 5 minutes before beginning to count the first minute as CO_2 is water soluble and must saturate the solution before reliable counts can be made.

Preparing Your CONTROL

8. Pour 100 mL water into the 250 mL flask
9. Add 10 g sucrose Table sugar; swirl to dissolve completely
10. Add 25 mL of the "source culture"; swirl to achieve homogeneity.
11. Insert the stopper and airlock onto the 250 mL Erlenmeyer flask.
12. CO_2 production will achieve a steady rate in about 5 minutes, at which time you will start taking your three 1-minute readings.

Experimental Runs

(For each set, make a graph! Bubbles/min [vertical]/dose [horizontal])

A. EVERY group does a CONTROL run plus their assignment (one of A through D).
B. Variable Substrate Concentration: GROUP 1
    1. **CONTROL**: 10 grams of sucrose is dissolved into the reaction chamber and the run is made.
    2. 5 grams of sucrose
    3. 15 grams of sucrose
    4. 20 grams of sucrose
C. Variable Yeast GROUP 2
    1. Make three runs using 12.5 mL, 25 mL (CONTROL) and 50 mL of "source culture", respectively.
D. Variable Substrate Type GROUP 3
    1. CONTROL: 10 grams of sucrose (reagent grade or table sugar)
    2. 10 grams of glucose (dextrose)
    3. 10 grams of sucrose (reagent grade or table sugar)
    4. 10 grams of ["pink"] Sweet'n'Low or Splenda

R E S U L T S ***

I. Each group is to report their work including making a graph of their results.
II. One person from each experimental group will summarize their results to the class.

Adapted from: Yeast Fermentation Lab, Biology 101 class, Paul D. Camp Community College, Smithfield, Virginia USA (Fall 2009)

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