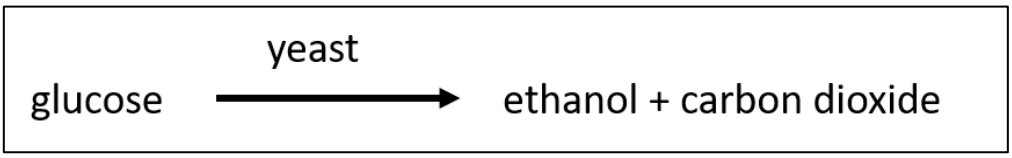
INFORMATION SHEET

Beer is an alcoholic beverage produced by the **fermentation** of a carbohydrate in the presence of yeast. Ethanol is the alcohol produced. Examples of carbohydrates (or sugars) include glucose, fructose, and sucrose. All these sugars are soluble in water. A sugar solution is made by adding a certain mass of sugar to a certain quantity of water. For example, a 2% sugar solution is made by dissolving 2 g of sugar in 100 ml of water. A simple equation of the fermentation process is shown below:

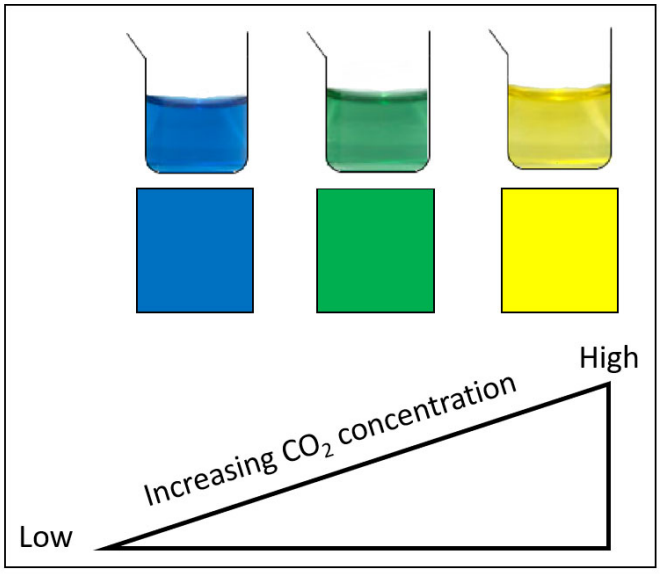


The **fermentation rate** of yeast can be calculated in a number of ways, for example:

- by counting the number of CO_2 bubbles produced in a given amount of time
- by measuring the quantity of glucose used in a given amount of time
- by measuring the quantity of ethanol produced in a given amount of time

Yeast is a unicellular (single-celled) fungus commonly used in brewing beer. Sometimes, beer gets spoiled by contaminating bacteria. **Bacteria** are also unicellular, but usually smaller than yeasts, and they do not have organelles. When working with living organisms, a method for safe disposal of microorganisms used in the laboratory should be taken into consideration. Soaking solutions with yeast or bacteria in a solution of bleach (sodium hypochlorite) for 20 minutes should make it safe for flushing down the drain.

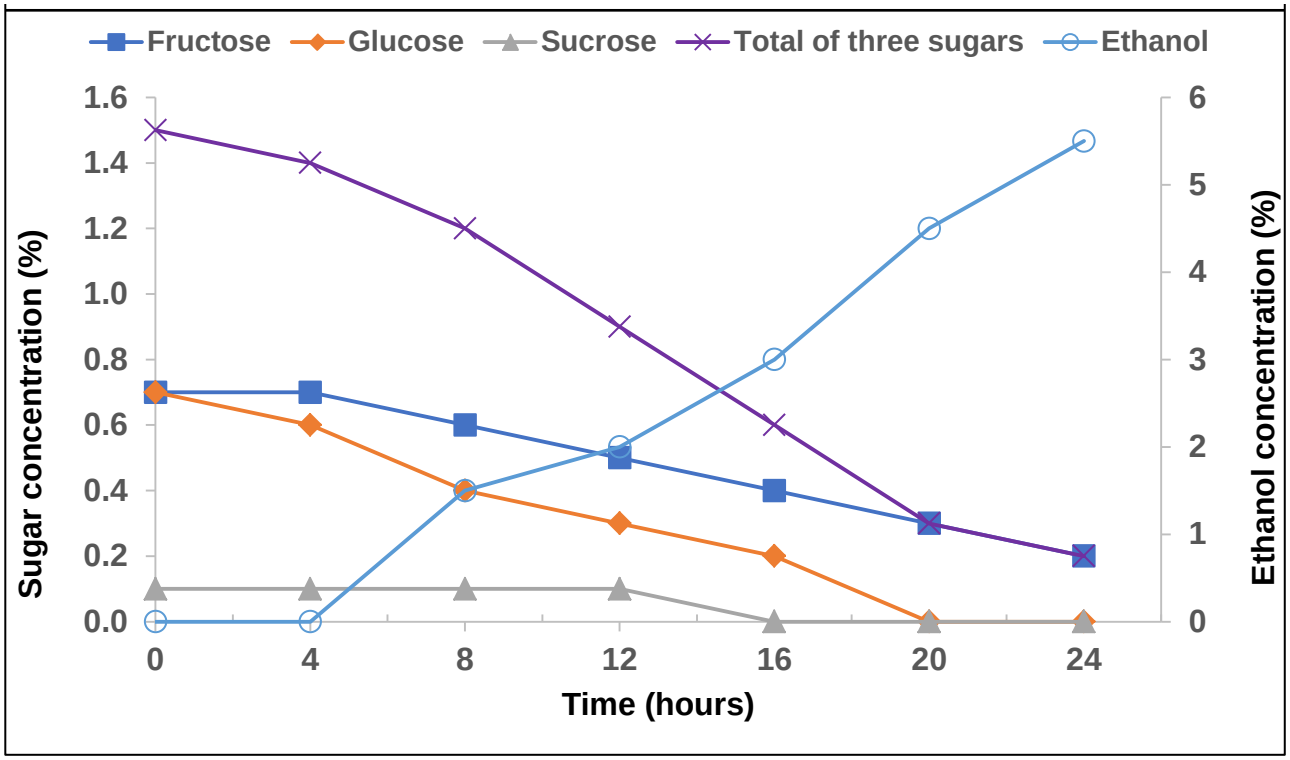
Bromothymol blue is a harmless pH indicator used to detect dissolved carbon dioxide (CO_2) in solutions. CO_2 dissolves in a bromothymol blue solution to form an acid. The indicator itself is blue and, in the presence of dissolved carbon dioxide, will change from blue to green and then yellow. A disappearance of the blue colour indicates that carbon dioxide has been produced, and this colour change is also an indication that fermentation has taken place.



[Adapted: <http://mslavenda.com/bromothymol_blue.htm>]

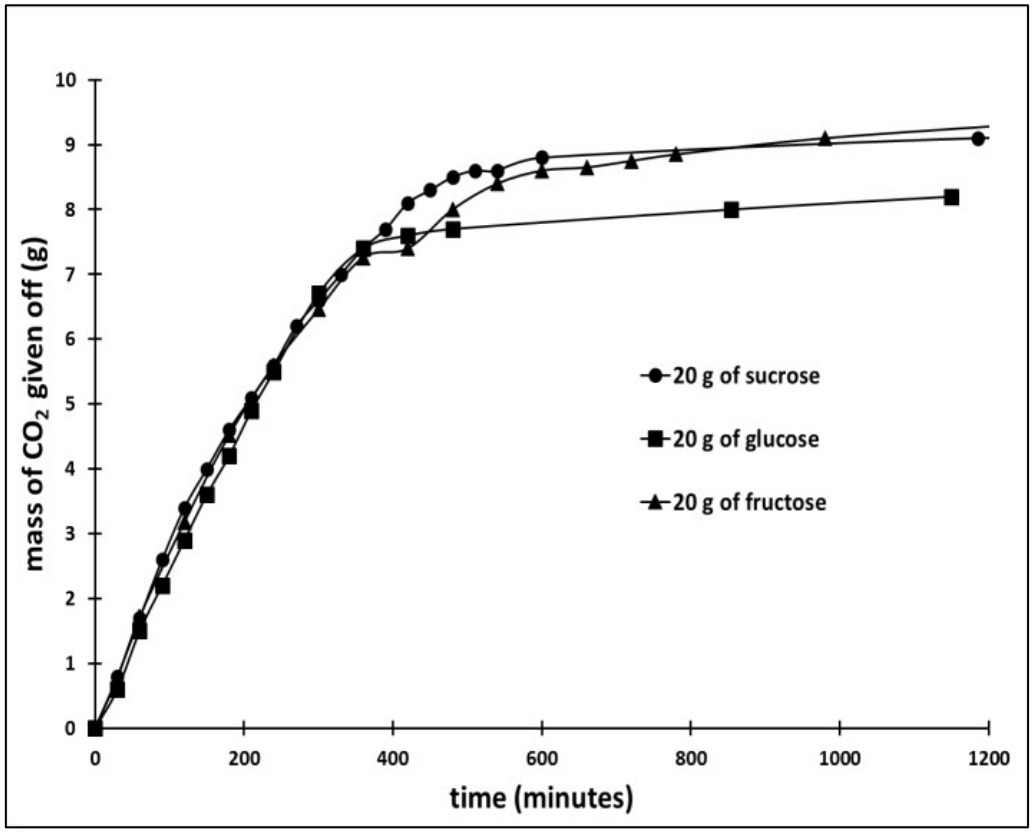
Graph X

The production of ethanol and breakdown of different sugars in the fermentation of yeast over 24 hours.



[Adapted: <https://www.researchgate.net/figure/Profiles-of-sugars-and-ethanol-for-STAR-yeast-fermented-at-33-C-and-zero-activation-days_fig1_266484222>]

Graph Y



[Adapted: <https://uwaterloo.ca/chem13-news-magazine/april-2015/activities/fermentation-sugars-using-yeast-discovery-experiment>]