Experiment – Fermentation of Ethanol

Background Information
The fermentation of common sugars to produce alkanols (alcohols) has been a natural process and human endeavour for centuries. The use of foods containing these sugars to produce the alkanol has produced a variety of alkanols. The chief alkanol used by humans is ethanol; however the side products of methanol and propanol may also be produced. While ethanol is consumed, methanol is a poison to the human system. Methanol is also called wood alcohol.

Aim(s)
- To produce ethanol by the fermentation of sugars
- To observe the conditions required for the fermentation of sugars to produce ethanol
- To measure mass changes associated with fermentation

Testable Hypothesis
If ..... (I do this – independent variable) ..... then ..... (this will happen – dependent variable change) ..... I think this will happen because ..... (a valid scientific reason).

Experimental Variables
Independent variable: _____
Dependent variable: _____
Control Factors: _____

Apparatus and Risk Identification

Apparatus Required			Risks Associated	
Conical flask	Rubber stopper	Fruit juice		Chemicals can be poisonous if used in an inappropriate manner
Brewers yeast	Glass tubing	Sodium meta bisulfate		Flammable material. No naked flames near the material
Electronic scales				Biological materials must be handled and disposed of in an appropriate manner

Method
1. ***Clean*** the equipment using the sterilizing chemical.
2. ***Carefully*** add the sample of fruit juice to a clean conical flask.
3. ***Accurately weigh*** the container and 'reactants', and record the weight.
4. ***Allow*** the water to reach an appropriate temperature before adding the yeast culture.
5. ***Secure*** the lid ensuring the air trap is firmly attached.
6. ***Top up*** the air trap with water as needed.
7. After the reaction has ceased, ***accurately weigh*** the container and products, and record the mass.
8. ***Calculate*** the mass change involved in the reaction.

Observations and Data Gathering
Write observations for the experiment
Use a simple table to record mass changes during the reaction

Analysis
1. ***Explain*** why the apparatus must be thoroughly sterilized prior to brewing
2. ***Explain*** why the water/wort mixture must be allowed to cool before the yeast culture is added.
3. ***Use*** an equation to explain the fermentation process.
4. ***Identify*** the conditions required for fermentation.
5. ***Identify*** the indicator(s) that the reaction has reached completion.
6. ***Explain*** why an air trap is required for the container.
7. ***Account*** for any changes in mass that occur during the reaction.

8. ***Find out*** how the alcohol content of the product can be determined.
9. A student performed this experiment and noted that after 7 days the mass of the reaction vessel did not change. ***Suggest*** why this occurred
10. The student also suggested that a limiting factor would exist to eventually stop the reaction. ***Identify*** a possible limiting factor for the reaction and ***explain*** your choice

Errors & Inaccuracies
1. ***Identify*** the sources of error in the method
2. ***Describe*** how the effect of each of these errors is minimised

Risk Management
1. ***Describe*** how each of identified risks associated with the experimental method are minimised

Conclusion
Write an answer to the aim(s) that is consistent and supported by observations and gathered data

Skip to navigation

Print Close

experiments

Fermentation of glucose using yeast

Beer and **wine** are produced by **fermenting glucose** with **yeast**. **Yeast** contains **enzymes** that **catalyse** the **breakdown** of **glucose** to **ethanol** and **carbon dioxide**. In this experiment, a **glucose** solution is left to **ferment**. Students then test for **fermentation** products.

Read our standard health & safety guidance

Lesson organisation

This experiment takes time. The solution needs to ferment between lessons, especially if you are distilling the final solution to produce ethanol.

Apparatus and chemicals

Eye protection

Each pair of students requires:

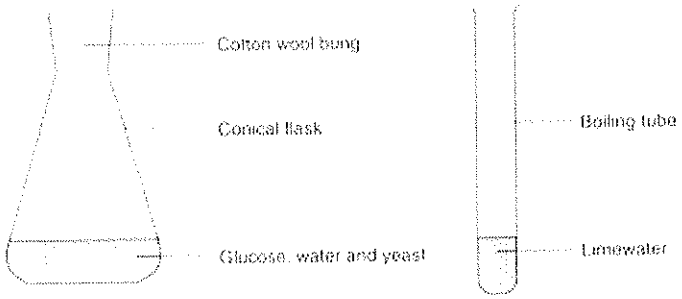
Conical flask (100 cm^3)
Boiling tube
Measuring cylinder (50 cm^3)
Access to a balance (1 dp)
Cotton wool
Sticky labels
Warm water 30–40 °C (see note 1)

Glucose (**Low Hazard**), 5 g
Yeast (as fast acting as possible), 1 g
Limewater

Technical notes

Glucose (**Low hazard**) Refer to CLEAPSS Hazcard 40C

1 A source of warm water is required. Larger conical flasks can be used, but this dilutes the carbon dioxide concentration, and makes testing for carbon dioxide with limewater more difficult.



Procedure

HEALTH & SAFETY: Wear eye protection

Lesson 1

a Put 5 g of glucose in the conical flask and add 50 cm^3 of warm water. Swirl the flask to dissolve the glucose.

b Add 1 g of yeast to the solution and loosely plug the top of the flask with cotton wool.

c Wait while fermentation takes place.

d Remove the cotton wool and pour the invisible gas into the boiling tube containing limewater. Take care not to pour in any liquid as well.

e Gently swirl the limewater in the boiling tube and note what happens.

f Replace the cotton wool in the top of the flask.

Lesson 2

a Remove the cotton wool and note the smell of the solution.

b The solution may be retained for a teacher demonstration of distillation.

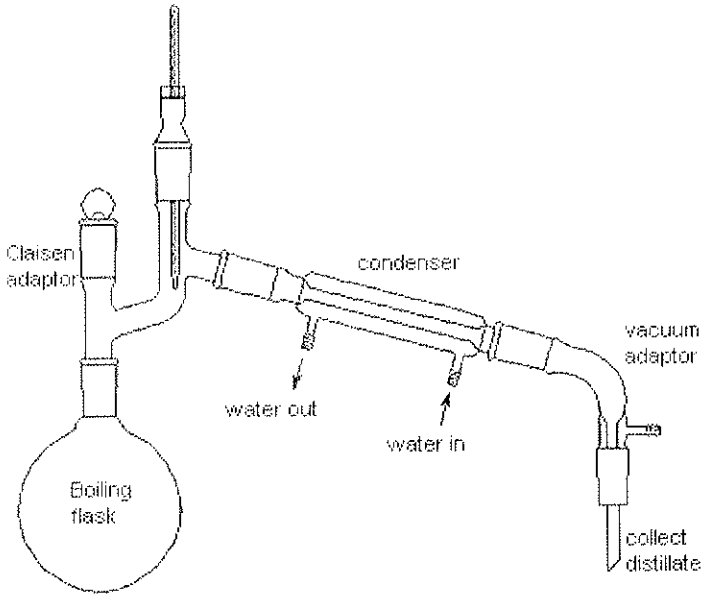
Teaching notes

Class results can be pooled to demonstrate distillation.

If you want to do this, carefully decant or filter the solution into your distillation flask. (Significant quantities of yeast will produce foaming and this can be carried over into the product.)

Collect the fraction between 77–82 °C. (Ethanol boils at 78 °C.) This fraction should burn easily compared with the non-flammable original solution.

The ethanol must be burnt or poured away immediately. It must not be kept or used.



If fermentation is not rapid because of the yeast used, then the whole experiment can be carried over to the second lesson.

Yeast has an enzyme called zymase and this catalyses the fermentation process.

Glucose zymase → Ethanol + carbon dioxide

$C_6H_{12}O_6$ (aq) → $2C_2H_5OH$(aq) + $2CO_2$(g)

Student questions
Here are some possible questions to ask students:
How do you know fermentation is taking place? Which gas does limewater test for? Suggest other methods for measuring the speed of this reaction.

Health and Safety checked, September 2007

Web Links

General information on glucose fermentation.

www.gcsechemistry.com/rc16.htm

(Website accessed March 2009)

Updated 25 Mar 2009