

## THE DISTILLATION

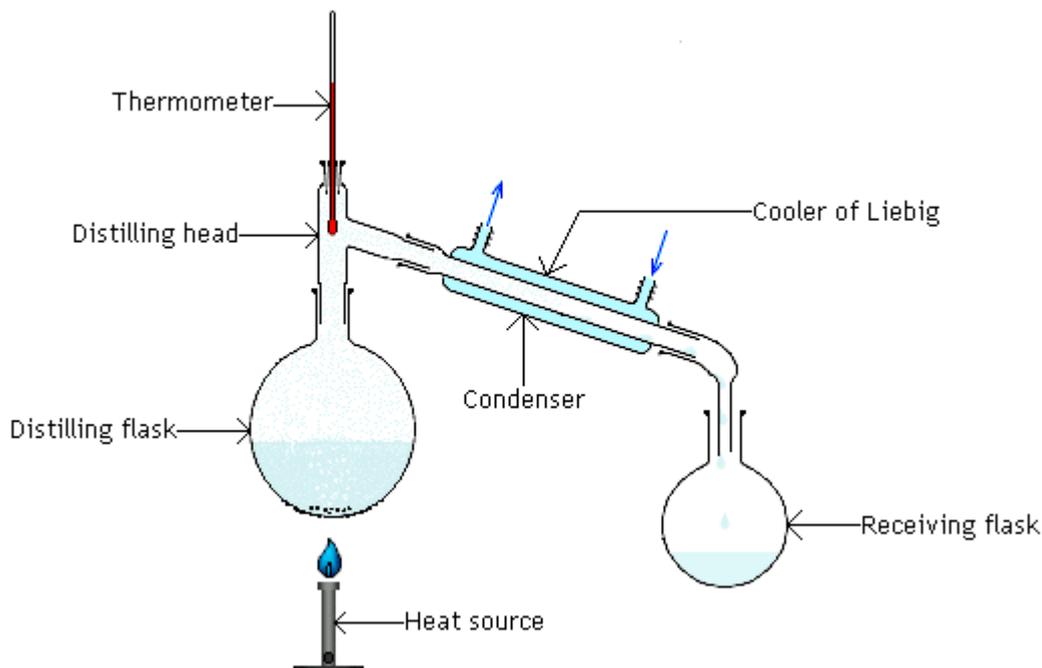
The principle of distillation is to separate the alcohol from the water, thanks to the difference in their boiling points. When the temperature of the cider reaches 80°C (176°F) only the aromatics and alcohol escape in a flow of steam.

Apple cider contains about 6% of alcohol and is used for the distillation of spirits. The most famous apple spirit is Calvados, which is produced in Normandy (France).

### EXPERIMENT: THE DISTILLATION OF CIDER

Fill 50ml of cider in the distilling flask, add 3-5 boiling stones, close the distillation apparatus and start the water cooling. Then start distillation by turning on the heating mantle. When the mixture boils, adjust the heat to maintain a distillation rate of approximately 1 drop per second. Stop the distillation when approximately 5ml of distillate has been collected.

*What does your distillation product look and smell like?*



<http://www.calvados-dupont.com/en/distillation-calvados-aging.htm>

<http://s1.e-monsite.com/2009/03/07/09/14780336simple-chem-distillation-png.png>

## WHY CUT APPLES TURN BROWN

### First Experiment:

Peel and grate half an apple and fill the apple into 6 beakers (one teaspoon each).  
the following substances:

beaker 1: nothing

some oxygen from the balloon

5ml of hydrogen peroxide solution:  $H_2O_2$

beaker 4: 5ml of ferric chloride solution:  $FeCl_3$  (3%)

beaker 5: 5ml of citric acid solution (5%)

beaker 6: 5ml of ascorbic acid solution (5%)



grated  
Then add

beaker 2:

beaker 3:  
(3%)

Wait about 5 minutes and observe the colour of the samples.

*What substances make the apples turn brown faster/slower?*

*How could you prevent the apple from turning brown?*

### Second experiment:

Put some of the prepared brown apple into three beakers and add the following substances:

beaker 1: 5ml of citric acid solution (5%)

beaker 2: 5ml of ascorbic acid solution (5%)

beaker 3: some lemon juice

*What can you observe?*

**Question:** Why do cut apples turn brown?

**Answer:** Apples and other products (e.g., pears, bananas, peaches, potatoes) contain an enzyme called polyphenol oxidase or tyrosinase that reacts with oxygen and iron-containing phenols that are also found in the apple. The oxidation reaction basically forms a sort of rust on the surface of the fruit. You see the browning when the fruit is cut or bruised because these actions damage the cells in the fruit, allowing oxygen in the air to react with the enzyme and other chemicals.

The reaction can be slowed or prevented by inactivating the enzyme with heat (cooking), reducing the pH on the surface of the fruit (by adding lemon juice or another acid), reducing the amount of available oxygen (by putting cut fruit under water or vacuum packing it), or by adding certain preservative chemicals (like sulfur dioxide). On the other hand, using cutlery that has some corrosion (as is seen with lower quality steel knives) can increase the rate and amount of the browning by making more iron salts available for the reaction.

<http://chemistry.about.com/od/chemistryfaqs/f/brownapplefaq.htm>

## **Fermentation: apple juice – cider - vinegar**

### **First experiment: Alcoholic fermentation**

In this experiment you compare the alcoholic fermentation of apple juice and saturated sugar solution. That fore put 100ml of apple juice into the first Erlenmeyer flask and 100ml of saturated sugar solution (70g of sugar + 40ml of water) in the second one. Add half a pack of yeast and a stir bar, lose the flasks with a balloon and put them on the magnetic stirrer. Heat gently (the temperature should not exceed 35 degrees) and observe for 10 minutes. While waiting read the text about fermentation below and answer the questions on the worksheet.

## WHAT IS FERMENTATION?

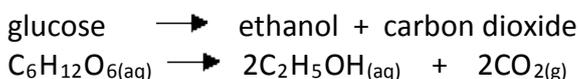
Fermentation is a process used to produce wine, beer, yogurt and other products. Fermentation is a metabolic process in which an organism converts a carbohydrate, such as starch or a sugar, into an alcohol or an acid. For example, yeast perform fermentation to obtain energy by converting sugar into alcohol. Bacteria perform fermentation, converting carbohydrates into lactic acid or acetic acid.

### History of Fermentation

Fermentation is a natural process. People applied fermentation to make products such as wine, mead, cheese and beer long before the biochemical process was understood. In the 1850s and 1860s Louis Pasteur became the first zymurgist or scientist to study fermentation when he demonstrated fermentation was caused by living cells.

### What is Ethanol Fermentation?

Fermentation is the name given to the process where a sugar (glucose) solution containing yeast is turned into alcohol (ethanol). The balanced equation for fermentation is



The carbon dioxide gas bubbles out of the solution into the air leaving a mixture of ethanol and water. Fermentation must be carried out in the absence of air to make ethanol. This is called anaerobic conditions. If air is present, ethanoic acid is made instead of ethanol.

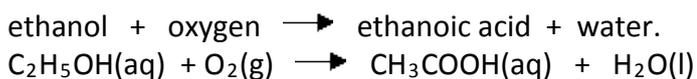
Ethanol fermentation is used the production of beer, wine, cider and bread. It's worth noting that fermentation in the presence of high levels of pectin result in the production of small amounts of methanol, which is toxic when consumed.

Fermentation will not happen without yeast. Yeast is a microorganism containing an enzyme which acts as a catalyst. Fermentation works best in warm conditions (between 18 and 35 °C) and at a neutral or acidic pH (between 4 and 7). Too cold and the enzyme in yeast is inactive, too hot and the enzyme denatures. The best products are generally made at the lower end of this temperature range although at lower temperatures fermentation is slower and takes longer.

When the alcohol concentration reaches about 10 to 14%, the alcohol damages the yeast and stops the fermentation. Ethanol can be separated from the mixture of water and alcohol by fractional distillation and this process can be used to make alcoholic drinks with a higher alcohol concentration such as brandy and whisky.

### What is Acetic acid fermentation?

When ethanol reacts with oxygen it forms a weak acid called ethanoic acid. In an open bottle of beer, cider or wine, the reaction happens naturally in the presence of bacteria, and it is the ethanoic acid that can make beer or wine taste sour.



Ethanoic acid is a weak acid. It is found in vinegar ("vinegar" is old french for "sour wine"). Vinegar is used as a food flavouring and preservative.

<http://chemistry.about.com/od/lecturenoteslab1/f/What-Is-Fermentation.htm>

<http://www.gcsescience.com/rc17-fermentation-yeast-alcohol.htm>

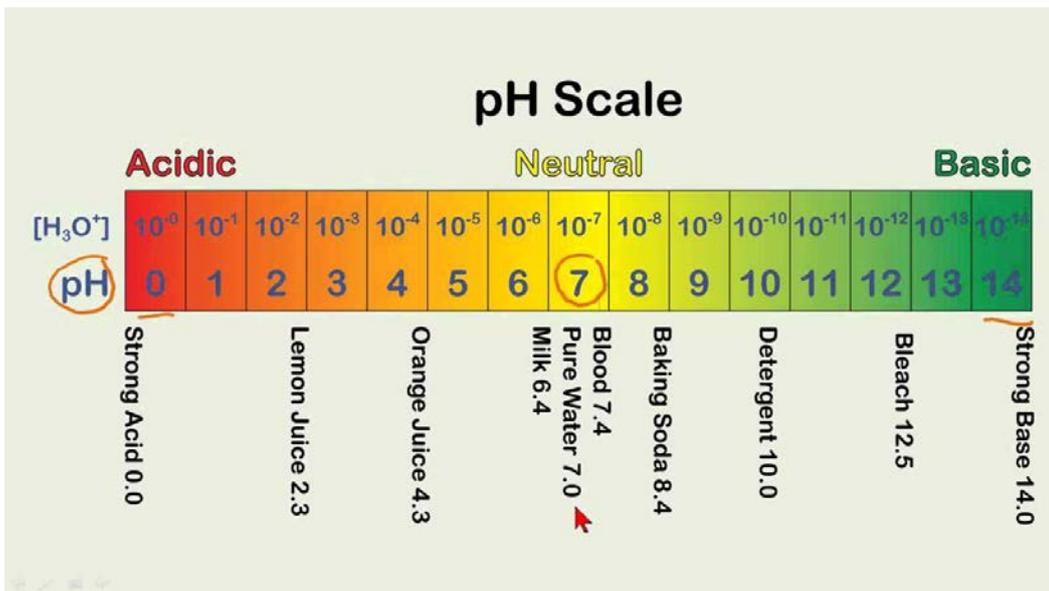
<http://www.gcsescience.com/o49.htm>

## SWEET OR SOUR?

First experiment:

Second experiment: pH value of apple juice, cider and vinegar

Measure the pH value in apple juice, cider and vinegar with test paper and a pH-meter. Which is most/less sour?



<https://www.bing.com/images/search?q=pH-scale&view=detailv2&id=CBEB9C95FA6C0DAC77DB9A8CA867AE1D3A5AA183F&selectedIndex=56&ccid=G2QQwmdr&simid=608018519234316935&thid=OIP.M1b6410c2676be41c90ad5fa0369ad1a6H0&ajaxhist=0>