

Fermented fizzy drinks



The forerunners of today's carbonated drinks were produced by fermentation, using yeast. The alcohol content of the drinks was kept very low by restricting the fermentation. This was achieved by refrigerating the drink, adding relatively little yeast and/or sugar or by allowing only a short fermentation period. The growth of contaminating bacteria is restricted by acidifying the drinks (yeast can tolerate low pH values). Many of these drinks were derived from traditional recipes and were produced for festivals or celebrations. Usually they were made at home or on a small scale rather than in large bottling plants or breweries. This activity presents several recipes for the production of fermented fizzy drinks on a small scale. This work is best done in a food preparation area rather than a science laboratory.

■ Curriculum links

This work ties in with several areas of the science curriculum. In addition to developing investigative skills, this work can be used to support teaching about:

- Respiration
- Health — the abuse of alcohol; the growth of microorganisms
- Elements, compounds and mixtures — the use of word equations
- Chemical reactions — chemical change in everyday situations brought about by living systems
- Acids and bases — the use of the pH scale

The work provides a context for considering multicultural issues and the use of ICT.

■ Age and ability range

This activity is suitable for Key Stage 3 pupils of all abilities.

■ Timing

The preparation of most of these drinks can be completed within a single 45 minute session, although some take significantly longer and are suitable only for a 'special project' outside the constraints of a normal lesson (see the recipes for details). Typically, the fermentation will take 3–10 days, depending upon the recipe. Bottling, if necessary, can take a further 45 minutes.

■ Advance preparation

Vessels and other equipment can be sterilized in advance if required. For some recipes, the ingredients can usefully be prepared in advance.

■ Suppliers

Most of the materials required can be obtained from a supermarket. If required, specialist equipment such as fermentation locks and sterilising agents can be purchased from home-brewing suppliers.

■ Equipment and materials

All of the equipment should be reserved for food-use only. Exactly what is required varies according to the recipe being followed. In general, students will require:

- Plastic bottles and caps
- Plastic funnels
- Plastic jugs
- Knives and chopping boards
- Large kitchen spoons for stirring
- Siphon tube
- Muslin or gauze for filtering
- Sterilizing solution (e.g., sodium metabisulphite — made up and used according to the manufacturer's instructions)

- Ingredients for the recipe being followed (see recipes)

The class or group will also need access to:

- a balance or scales
- hot water for cleaning containers and making up solutions
- thermometer
- large plastic fermentation bin or similar, in which to sterilize the bottles and utensils

■ Safety

General guidelines

This work should be carried out in a food preparation area, not a science laboratory. All equipment and materials should be suitable for food use, and where necessary, vessels and utensils should be cleaned and sterilised using a sterilising agent that is intended for use on food containers (e.g., a proprietary sodium metabisulphite solution). The manufacturer's instructions should always be followed when using sterilising agents.

The role of the yeast in this activity is to produce carbon dioxide, not alcohol. This should be emphasized to pupils. Note that some religions may object to the use of fermentation to produce drinks, even if alcohol is not produced or is present only in small amounts.

Street ginger beer seller, London, 1877.



Specific guidelines

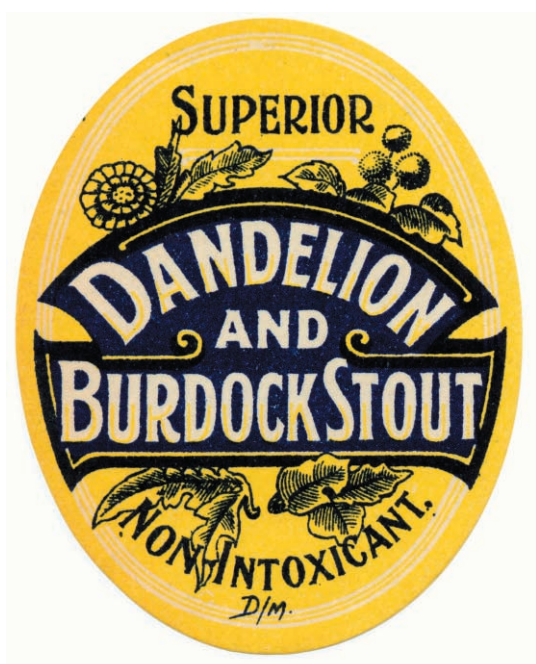
Vessels used for fermentation should be adequately vented to allow carbon dioxide to escape. *There is a serious risk of explosion if this is not done.*

Bottled drinks should be kept refrigerated and consumed within 6 days. Refrigeration will slow the fermentation and reduce the risk of spoilage or 'gushing' through over-carbonation when the bottles are opened.

Teachers should exercise their discretion when deciding whether pupils should be allowed to consume a particular drink they have made!

■ Additional activities

- Most of these drinks are acidified to inhibit bacterial growth. Pupils could investigate the effect of pH on the rate of fermentation (12 g of citric acid is roughly equivalent to adding the juice of one lemon).
- Some spices e.g., cinnamon, are thought to inhibit the growth of microbes. Pupils could devise and carry out an experiment to test this. Pupils could consider the implications of their findings for the recipes and methods of soft drink production.
- The first root beers were sold as sachets of dried herbs and spices. Could similar kits be devised for other drinks e.g., ginger beer?
- Pupils might investigate methods of measuring and control the alcohol content of a product, to ensure that it was not excessive (e.g., use of a hydrometer).
- Some religious groups object to alcohol consumption or even the consumption of products that contain no alcohol but have been produced by brewing. Pupils could be encouraged to find out about this and consider the implications for drinks like those described here.
- All of these drinks contain live yeast. Consequently they have a short shelf life and there is a danger that the bottles might explode. Pupils might investigate ways of overcoming this problem. These might include one or more of the following:
 - selling the product as a fresh drink that has to be stored under refrigeration;
 - filtering the yeast from the drink before bottling it;
 - precipitating the yeast with a fining agent before bottling;
 - pasteurising the drink before bottling, to kill the yeast;
 - adding a chemical preservative to the drink to kill the yeast;
 - using a type of yeast that precipitates (floculates) naturally;
 - increasing the sugar content so that the yeast cannot grow (osmosis);
 - designing a special bottle that allows excess gas to escape while maintaining the fizz and preventing contamination of the drink.





- Pupils could carry out a sensory evaluation of their product, using statistical tests. Suggestions for suitable tests are available from the NCBE's Web site (www.ncbe.reading.ac.uk — look under 'Protocols')
- Carbon dioxide production can be measured by collecting the gas over 13% brine solution (carbon dioxide will not dissolve in such a saturated solution). The NCBE has also devised an electronic 'bubble counter', that counts bubbles passing through a standard glass fermentation lock. This device can be used by itself or linked to a datalogger to provide an automatic measurement of the rate of fermentation. Details of the bubble counter (including a circuit diagram) can be obtained from the NCBE's Web site. (www.ncbe.reading.ac.uk — look under 'Materials')

■ For more information

Homemade root beer, soda, and pop by Stephen E. Cresswell (1998) Storey Books, Vermont. ISBN: 1 58017 052 8.

This is an excellent book with more than 60 recipes for non-alcoholic fermented drinks, with hints about bottling, cleanliness, the production of concentrates from raw ingredients, etc.

Beer. Tap into the art and science of brewing by Charles Bamforth (1998). Plenum Press, New York. ISBN: 0 306 457 0. *Detailed information about the science behind conventional beer brewing.*

The science of brewing (1998)

PC CD ROM B³ Media, PO Box 1017, Kingshurst, Birmingham B37 6NZ.

Produced for schools by Kingshurst City Technology College.

For God, country and Coca-Cola by Mark Prendergast (2000) Revised edition. Orion Business Paperbacks, London. ISBN: 1 84203 042 6.

The definitive history of the world's most popular soft drink. Coke was never a fermented drink, but this revealing and fascinating account shows the context in which many patent medicines were developed after the US civil war and eventually became soft drinks.

Microbial growth 3. PC Simulation software for microbiology. Scotcal Software, Swansea. Available from: Scotcal Software, 63 Heol Brithdir, Birchgrove, Swansea SA7 9PZ.

Tel: 01792 813666. www.scotcal.com

Superb software which has won many awards. Scotcal also has an excellent and useful Web site.

Fentimans Ltd in Newcastle-upon-Tyne still make non-alcoholic drinks (e.g., ginger beer and lemonade) by fermentation. www.fentimans.com