

A5. Citric acid

This is a text based activity concerning citric acid.

Answers for questions on Pupil activity sheet A5:

1. To calculate the angles required to produce a pie chart for soft drinks $48/100 \times 360 = 172.8^\circ$
for health salts $8/100 \times 360 = 28.8^\circ$ and so on.
2. A table seems the most appropriate form of presentation; its content will vary depending on the labels.
- 3.

Type of food product	Function in this product
beverages and soft drinks preservatives	taste; buffering properties; increase effectiveness of
jams and jellies	sour taste; acidic pH needed to make products set
frozen food	chelating agent; prevents colour and flavour deterioration
fats and oils	prevent oxidation
processed cheeses	emulsifying salt
whipping cream	stabiliser
vegetable based dairy substitutes	stabiliser
seafood	increase effectiveness of preservatives and antioxidants
cured meat products	increase effectiveness of preservatives and antioxidants; modifies texture

KS3/4

science and food technology;
possibly a homework written exercise

Timing - 20 - 30 minutes

Two pupil activity sheets A5 accompany this activity.

chelating agent - removes trace metals which enhances the performance of antioxidants

substances are given pH values between 1 -14; acids have values <7, alkalis have values >7; pH 7 indicates neutrality.

4. a. **pH** - measurement of acidity or alkalinity of a system.
b. **Buffer** - substances which are capable of reducing excess acidity/alkalinity so that the final pH remains the same.
c. **Emulsions** - formed when tiny drops of one liquid are spread evenly through a second liquid; there are many examples of foods which are emulsions, such as ice cream, margarine and mayonnaise.
5. Foods containing **preservatives**; some examples:
pizza (pepperoni with cured pork and beef sausage), sodium nitrite E250
mayonnaise, potassium sorbate E202
chocolate Swiss roll, potassium sorbate E202
Belgian buns, sodium propionate E281, sodium benzoate E211
naan bread, calcium propionate E282
6. Foods containing **antioxidants**; some examples:
cheese and ham pasties (the ham), sodium ascorbate E301
pizza (as above), sodium ascorbate E301
vinaigrette, butylated hydroxyanisole (BHA) E320

Many of the foods we eat are acidic, that is they contain acids. This explains their sharp taste. Natural foods like oranges, lemons, apples, tomatoes, cheese and yoghurt are all strongly acidic. Citrus fruits contain citric acid, apples and pears contain malic acid, cheese and yoghurt are rich in lactic acid.

Citric acid was first extracted from lemon juice about 200 years ago. It is the most versatile and widely used **acidulant**. It is found abundantly in nature. It is used extensively in foods, beverages and the pharmaceutical industry.

Tasks

Citric acid is economically very important. It is manufactured in 20 countries with world wide production, in 1997, in the region of 750 000 tonnes. Just over 35% of citric acid is manufactured in Europe, where about 250 000 tonnes of citric acid is used each year.

The table below shows the % use of citric acid in the UK.

PRODUCT	% USE
soft drinks	48
health salts	8
other foods	12
confectionery	9
detergents	16
other uses	7

1. Construct a pie chart to illustrate these figures.
2. Collect food labels and non-food product labels, like some medicines, where citric acid, E330, or its salts, E331, E332, E333, are present. Display your findings in a suitable way.

Answer the following questions after you have read the information about citric acid (on next page).

3. Make a table which summarises the functions of citric acid and its salts in food. The first column should show the type of food product. The second should show the function of citric acid.
4. What is meant by:
 - a. **pH**?
 - b. a **buffer**?
 - c. an **emulsion**?
5. From food labels, find the names of two food products which contain a **preservative**. Write down the name of the food, the name of the preservative and the E-number.
6. From food labels, find the names of two food products which contain an **antioxidant**. Write down the name of the food, the name of the preservative and the E-number.

"Citric acid is used extensively in food and industrial applications because it has many important chemical properties.

Citric acid (E330), sodium citrate (E331) and potassium citrate (E332) are widely used in beverages and soft drinks. A combination of these three substances is used to give flavour, provide buffering properties and increase the effectiveness of preservatives.

In jams, jellies and preserves, citric acid is used to give a sour taste. An acidic pH (<7) is also needed for these products to set properly, i.e. to produce a gel. Citric acid is able to combine with free metals in foods that are frozen. This is described as being a chelating agent. This is important since it enhances the actions of antioxidants. Citric acid also prevents colour and flavour deterioration in frozen food.

The oxidation of fats and oils in food products can be prevented by the addition of citric acid. It acts, again, by removing trace metals.

Sodium citrate acts as an emulsifying salt in processed cheeses. It modifies the protein in the cheese enabling it to form an emulsion between the water and fat. This prevents the separation of these components and improves the body and texture of the cheese. Sodium citrate is also an important stabiliser in whipping cream and vegetable based dairy substitutes.

Citric acid is used in seafood and cured meat products to increase the effectiveness of colours, flavourings, preservatives and antioxidants. It also modifies the texture of meat products.

Citric acid and citrate salts have a number of medical uses. They are used as buffers in a wide range of pharmaceutical products. Effervescent formulations (such as Alka Seltzer) contain a mixture of citric acid and sodium bicarbonate to assist dissolving and to improve taste. Sodium citrate is added to human blood to prevent coagulation before it is used in transfusions, etc.

Citric acid has many industrial uses, such as a laundry detergent, and a number of agricultural uses. Other uses include the production of concrete and mortar, a blowing agent in plastic production and an important component of many cosmetics and toiletries.

It is a truly versatile compound!"