C1. "It looks good enough to eat!"

Pupils investigate whether the colours of a variety of foods and colourings are affected by the addition of acids and alkalis.

Additional hints

In addition to the foods suggested pupils could also try rosehips, black and green grapes, blackberries, blueberries, peppers (red/green/yellow/orange), turmeric

(E100 curcumin).
It is not critical to measure exactly the masses or volumes. The time for which you leave the mixtures is also not critical.

Answers to questions on pupil activity sheet C1:

(The optional results sheet (third C1 sheet) can be photocopied for pupils to use.) The answers below assume that the foods mentioned in the requirements are used. You will need to alter the questions on sheet C1 if pupils use other samples.

1. beetroot and red cabbage only
2. beetroot, blue colouring, red cabbage, pink colouring
3. carrot, onion, probably green cabbage, onion skin
4. In alkali the green cabbage and onion become very brightly coloured. Bicarbonate of soda (sodium hydrogencarbonate) is an alkali. In the past, it was added during the cooking of green vegetables to make them look a bright colour. However, it destroys Vitamin C (present in the food) so its use is no longer recommended.
5. Orange squash is normally packed in transparent containers. The light might make an orange squash containing carotene fade whilst it was on the shelf or at home. This would probably be unacceptable to the consumer.
6. a. There would probably be no objections from the public about health safety; the marketing people would probably like it because they could make a big issue on the packet saying something like 'contains no artificial colours'; the company itself may think that using natural colours is preferable to artificial colours.

   b. If the food that the colour is to be used in is acidic or alkaline the colour may change to an unsuitable colour (whatever 'unsuitable' means in this case!); if the food changes in acidity or alkalinity before being consumed it may change colour; many of these natural colours seem to fade in the light - not suitable for a product in a clear container standing on a shelf for, maybe, weeks; some of these natural colours are expensive; adding other acid or alkali foods to them at home may change their colour.
7. This allows pupils to express an opinion. They may suggest to use names rather than E-numbers because E-numbers do not seem to be popular with the public and a product may be rejected merely because it contains them, regardless of the nutritional quality, or other qualities, of the product.

   They may repeat the marketing views.

KS3
science and food technology

Timing - 30 - 40 minutes

Two pupil activity sheets C1 (plus optional results sheet) accompany this activity.

Requirements

- *balance accurate to 1 g*
- *knives or other appropriate cutting equipment*
- *white tiles or similar as a cutting surface*
- *petri dishes or watch glasses (3 containers are needed for each sample to be tested)*
- *distilled water*
- *any bench acid such as 2M hydrochloric acid, HCl or 2M nitric acid,* HNO_3
- *alkali such as 2M sodium hydroxide, NaOH*
- *teat pipette (those which have approximate volumes would be useful)*
- *samples of food (ca. 10 g) and food colourings [the following work very well: fresh beetroot, red cabbage, green cabbage, carrot, onion, - the brown outside onion skin (only 5g)]*
- *food colourings (the ones trialled were pink (E127), yellow (mixture of E102 and E110), orange (E110) and blue (E123)*
- *pieces of white paper on which to stand the dishes*
- *safety goggles*

Question 7 creates an opportunity for pupils to carry out some research into consumers' perceptions of E-numbers and chemical names. Pupils may like to devise some sort of questionnaire where lists of food ingredients are shown to consumers and the 'acceptance' or otherwise of E-numbers or chemical names is tested. For example, the same product could be shown with E-numbers only in one part of the test and with chemical names only in a different part, without the interviewee's knowledge. Is one more 'acceptable' to consumers than the other?

For example, the following lists are of the *same* product (which is an orange squash; both lists are legal):

water, glucose syrup, oranges, E330, flavourings, sweeteners (E951, E954), preservatives (E211, E223), stabilisers (E466, E414), antioxidant (E300), colours (E160(a), E160(e))	water, glucose syrup, oranges, citric acid, flavourings, sweeteners (aspartame, saccharin), preservatives (sodium benzoate, sodium metabisulphite), stabilisers (sodium carboxymethylcellulose, gum acacia), colours (beta-carotene, beta-apo- carotenal)

"IT LOOKS GOOD ENOUGH TO EAT!"

We are all attracted by food that looks good. Dull, grey food appears extremely unappetising and is not what we have come to expect. Our world is full of colour and many of these coloured things are good to eat.

In this investigation you are going to have a look at some coloured substances. You are going to see if they are affected by adding acids and alkalis to them. You will be asked to think about some of the consequences of your observations on the food we eat.

Read the safety note before you begin.

SAFETY NOTE
BE CAREFUL WITH KNIVES OR BLADES.
DO NOT CUT TOWARDS YOURSELF.
DO NOT EAT OR TASTE ANYTHING IN THIS INVESTIGATION.
ACIDS AND ALKALIS CAN BURN YOU.
WASH OFF ANY SPLASHES STRAIGHT AWAY WITH PLENTY OF WATER.
TELL YOUR TEACHER WHAT HAS HAPPENED.

In each series of tests, the petri dishes should be placed on a piece of white paper so that differences in colour are easier to see.

Method

1. Weigh out three samples of beetroot. Each sample should be about 10 g.
2. Chop up each sample and place in a petri dish.
3. Add about 5 cm^3 of distilled water to the first sample.
4. Add the same amount of distilled water to the second sample. Also add about 1cm^3 of acid to this sample.
5. Add the same amount of distilled water to the third sample followed by 1 cm^3 of alkali.
6. Take 3 more petri dishes.
7. In each of them place three drops of blue food colouring. Repeat steps 3 - 5, adding the water, acid and alkali to the food colouring.
8. You will be given a variety of other things which you are going to test in the same way.
   If the substance is another vegetable, treat it in the same way as the beetroot.
   If the substance is a liquid, treat it in the same way as the blue food colouring.
9. Leave all of your samples for about 5 minutes then look at them carefully.
   If you tilt each dish you can see if any coloured liquid is present.

   Construct a table into which you can put all your observations.

Questions

1. Which foods produced a coloured liquid when only distilled water was added?

2. Which samples changed colour, (from their colour in water), when acid was added?

3. Which samples only produced coloured liquids when alkali was added?

4. Look at the results for the onion and green cabbage in the alkali. Cooks used to add a pinch of bicarbonate of soda (sodium bicarbonate) to vegetables such as sprouts and cabbage during cooking. Why do you think they did this? It is now understood that adding bicarbonate of soda is **not** a good thing to do. Find out why.

5. The yellow/orange colour from the carrots is called carotene. It is a colour that quickly fades in the light. Why might food manufacturers decide that this was an unsuitable colour to use in orange squashes?

6. The colourings from the beetroot, carrot, green cabbage and red cabbage are obviously all **natural substances**. All of them can be used as food colouring. Their names and E - numbers respectively are:

beetroot	E162	betanin
carrot	E160(a)	alpha, beta and gamma carotene
green cabbage	E140	chlorophyll
red cabbage	E163	anthocyanins

   Think of reasons why food manufacturers:

   a. might want to use these natural colours in food products instead of using artificial colours;

   b. might think they are unsuitable for food use.

7. Imagine you are designing the label for a food which uses one or more of the natural colours named in question 6. In the list of ingredients would you advise the manufacturer to put just the names of the colours, just their E - numbers or both names and numbers? Why?

Some foods, like table jellies and boiled sweets, are colourless when they are first made. Manufacturers then add different colours so that these foods 'look' flavoured.

How natural food colours are affected by acids and alkalis

Substance	Colour in water	Colour in acid	Colour in alkali
beetroot			
blue colouring			
carrot			
onion			
red cabbage			
green cabbage			
onion skin (brown outside)			
orange colouring			
yellow colouring			
pink colouring			

HOW DO YOU COLOUR A JELLY BABY?

The manufacturers of jelly babies add colours to these sweets. Different manufacturers add different colours. Can you tell the flavour and colour of a jelly baby if you don't look at it before you eat it? Try this out!

In this investigation you are going to remove the colours from jelly babies and transfer the colours to long pieces of wool.

Read the safety note before you begin.

SAFETY NOTE
DO NOT EAT OR TASTE ANY OF THE SUBSTANCES USED IN THE INVESTIGATION.
BEWARE! YOU WILL BE USING HOT WATER!
YOU WILL BE USING DILUTE ACID. WASH OFF ANY SPLASHES WITH PLENTY OF WATER. TELL YOUR TEACHER WHAT HAS HAPPENED.
REMEMBER TO WEAR GOGGLES

Method

1. Place two red jelly babies in a small beaker. Add 10 cm^3 of distilled water.
2. Heat this and stir with a stirring rod until the jelly babies dissolve. This should only take a couple of minutes.
3. Add 1 cm^3 of dilute acid to the beaker and stir.
4. Add one length (about 50 cm) of pure white wool to the beaker. Cover the beaker with a watch glass.
5. Carry on heating the mixture for about three minutes.
6. Using your stirring rod, remove the wool and place it in an empty beaker. Wash the wool thoroughly using plenty of distilled water. Allow the wool to dry.
7. Repeat this method with the jelly babies of the other colours.

Questions

1. What happened to the water when you dissolved the jelly babies?
2. What happened to the wool when you put it in the jelly baby solution?
3. Make a display of your results.