G1. A jamming session

KS3/4
science and food technology

Timing - 30 - 40 minutes

Pupil activity sheet G1 accompanies this activity.

Requirements (per group)
- *safety goggles*
- *<25 cm³ commercial* pectin solution*
- *7 g ordinary sugar (sucrose)*
- *5 test tubes/boiling tubes*
- *test tube racks*
- *2 stirring rods*
- *tiny amount of citric acid powder*
- *2 water baths (beakers); 1 boiling, 1 cold*
- *Bunsen burner, tripod, gauze, heat resistant board*
- *stopclock*

* *Certo produced by Citrus Colloids, can be purchased from supermarkets and is a type of pectin which would be used to produce jam and marmalade in the home.*

The initial investigation, which finds out which conditions are necessary for gel formation using liquid **pectin**, is suitable for both science and food technology. There are then further investigations; one for science and the other for food technology.

Hints for the teacher

- The quantities of substances and times specified are very important.
- The commercial pectin is, itself, quite a viscous liquid and this must be measured into the tubes by *mass* rather than volume. For the initial investigation it may be better to have the pectin already added to the tubes ready for pupils to use.
- A small amount of citric acid powder, no more than 0.2 g, is all that is needed. Collect a small amount on the end of a spatula, or similar, and tap into the appropriate tubes. The contents of the two tubes that contain sugar should be stirred when the sugar is added and every minute during heating. This helps the sugar to dissolve and therefore prevents its accumulation at the bottom of the tube. The stirring rods should be removed during the cooling period.

The method suggested for comparing the tubes after cooling is very simple and qualitative. At this point in the investigation it is all that is needed. The pupils compare viscosity of the liquids in the tubes by laying the tubes flat. 5 minutes is long enough to see an obvious difference between tubes C and E. The pupils will find:

- That the liquid in tube E is most viscous; a gel is produced in the given setting time. None of the others produce the same set.
- Tube C will be more viscous than A, B or D, which will all be very similar.

This investigation demonstrates to pupils that pectin, to be able to produce a set, requires:

- heating
- an acidic pH
- and sugar.

Further investigations

Allow 15 minutes - to perform a number of tests and repeats

Variables to investigate:
- *amount of pectin*
- *amount of sugar*
- *length of heating at a particular temperature*
- *different temperatures but same length of heating.*

In science - the conditions needed for gel formation can all be used as continuous variables for a Sc1 investigation. However, since the amount of citric acid required is so small, it would not be particularly easy to investigate this variable. The others are much easier to investigate, (see margin). Whichever variable is chosen there should then be evidence of fair testing by keeping the other variables constant. There is also the need for pupils to devise a quantitative method of comparing the results; for example, liquid flow could be carried out against a graduated scale and timed; the contents of the tubes could be poured into a suitable container and the area of 'spread', in a particular time, measured.

In food technology - here, there is opportunity for jam making investigations.

Groups could make small quantities of jam using different methods of producing a set and then compare the jams (see margin box).

Different groups produce jams using different methods and then devise methods of comparing the jams with respect to setting properties, taste, colour and keeping qualities.

This activity could include work on producing jams using artificial sweeteners, as yet another comparison, which would lead to a discussion of the preserving properties of sugar that artificial sweeteners fail to have. It is advised that jams produced using artificial sweeteners are stored in the refrigerator to slow down microbial, particularly fungal, growth. Pupils could compare the keeping qualities of ordinary jams and jams made using artificial sweeteners under normal usage, e.g. opening lids, removing jam, returning the lid, etc.

Additionally, the production of small quantities of jam at home could be compared to the commercial production of jam on a large scale (see G2 *An introduction to pectin*).

Fruit such as strawberries, raspberries and cherries have low amounts of pectin and a high pH so that making jam from these fruits is more difficult.

There are two main ways of overcoming these problems:

- *often small quantities of other fruits which are high in pectin and acid are added to supplement that in the original fruit.*
- *alternatively, commercial pectin, and sometimes lemon juice, can be used.*

A JAMMING SESSION

The production of jams is a very old and traditional method of preserving fruit. At the end of summer there is a large quantity of surplus fruit and vegetables that must not be wasted.

Jams and marmalade are made by boiling the fruit with water and sugar. On cooling the jam or marmalade will set. This is due to a special group of carbohydrates called **pectins**. In the correct conditions, pectin will produce a **gel**. Some fruits, e.g. apples, blackcurrants, contain a large amount of pectin. They can easily be turned into jam. Other fruits, e.g. strawberries, raspberries, have a low amount of pectin and need help to be turned into jam.

In this investigation you are going to find the conditions needed for pectin to produce a gel and, hence, the conditions needed for making jam.

SAFETY NOTE
REMEMBER TO WEAR GOGGLES

Method

It is very important that you measure the substances accurately.

You must also time accurately the different parts of this investigation.

1. Label five test tubes A - E.
2. Add 4 g of commercially produced pectin to each of the tubes.
3. Heat a beaker of water to use as a water bath.
4. Treat the tubes as follows:

   Tube A - leave as a control

   Tube B - no other additions

   Tube C - add 3.5 g of sugar

   Tube D - add a tiny amount of citric acid powder

   Tube E - add 3.5 g of sugar and a tiny amount of citric acid powder
5. Stir tubes C and E with different stirring rods.
6. When the water bath is boiling, place tubes B, C, D and E into it for 5 minutes. You will need to stir tubes C and E every now and then.
7. After 5 minutes remove the tubes and place them in a cold water bath to cool them down. Take out the stirring rods. Leave the tubes to cool for 5 minutes.

Results

You now need to compare the contents of the tubes to estimate how thick or viscous the liquid is and whether or not a gel is forming.

A simple way of doing this is to tilt the tubes and see how fast the liquid travels down the tube. Make this a fair test.

Write up your investigation. Put the tubes into a rank order by putting the thickest (most viscous) at the top and the thinnest (least viscous) at the bottom.

What conditions are needed for pectin to be able to produce a set?