The chemistry of food

Activity 1: identifying food colourings in soft drinks

Equipment (per group)

- Cocktail sticks/tooth picks
- Artificial food colourings
- 1% sodium chloride ($NaCl$) solution
- 2 × 250 cm^3 beakers
- Watch glass
- Ruler
- Sharp pencil
- Concentrated extracts from soft drinks
- 2 × TLC plates

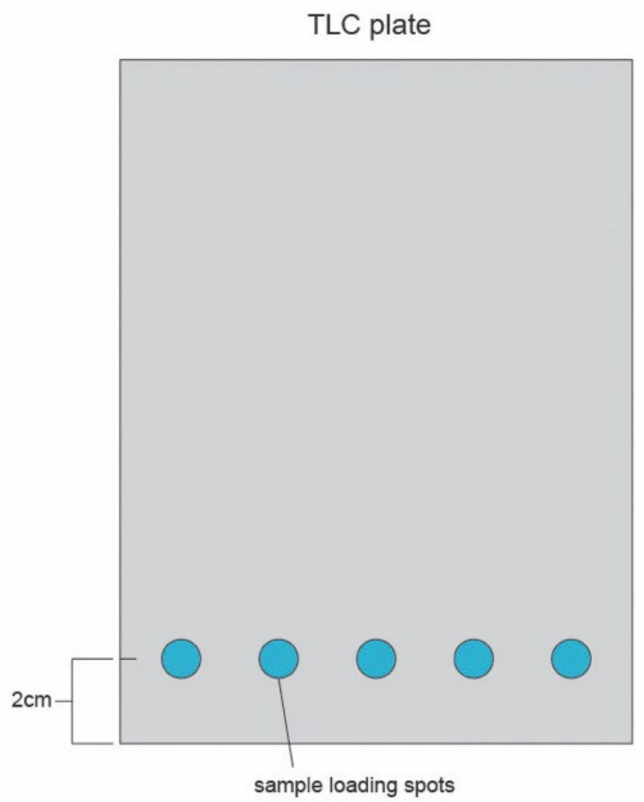
Safety and hazards

Wear safety glasses and a lab coat when instructed to.

To do

1. Carefully place the thin-layer chromatography (TLC) plate on the desk in front of you. Always hold the plate by the edges only, to make sure you avoid getting the oils from your fingers onto the plate itself.
2. Using a sharp pencil and ruler, draw a very faint line about 2 cm from the bottom of the plate. Make a pencil mark on this line every 15 mm.
3. Using a toothpick, place a small dot of the first sample of food colouring on a mark on the pencil line. It is important to make the spots very small. Usually, one touch with a toothpick is enough.

4. Label each dot in pencil.



5. Repeat until you have spotted all the food colourings separately across the bottom of the plate.

6. Place a thin layer (approximately 0.5 cm) of 1% sodium chloride solution (solvent) in the bottom of the beaker.

7. Place the spotted plates in the tank, spotted end down (spots must remain above the solvent level) and place a watch glass over the top of the beaker.

8. Repeat this procedure on a fresh TLC plate using the concentrated extracts from soft drinks.

9. Allow the solvent to rise to near the top of the plate. This may take up to an hour. Then remove the plate from the solution.

10. Use the method in your workbook (the table in question 2) to find the artificial colourings that are used in the soft drinks.

Activity 2: finding the vitamin C content of fruit juice

You will use the reaction between iodine and vitamin C (ascorbic acid) to calculate the amount of vitamin C in a sample of shop-bought, high vitamin C content, orange juice. Do not drink any of the juice.

Equipment (per group)

Burette and stand

250 cm^3 conical flasks

White tile

100 cm^3 measuring cylinder

10 cm^3 syringe for measuring the starch solution

100 cm^3 beaker for collecting iodine solution

Distilled water

0.00125 M iodine solution

0.5% starch solution

Funnel

Glass rod

Pasteur pipette

Fruit juice

Safety and hazards

Wear safety glasses in the lab when instructed to.

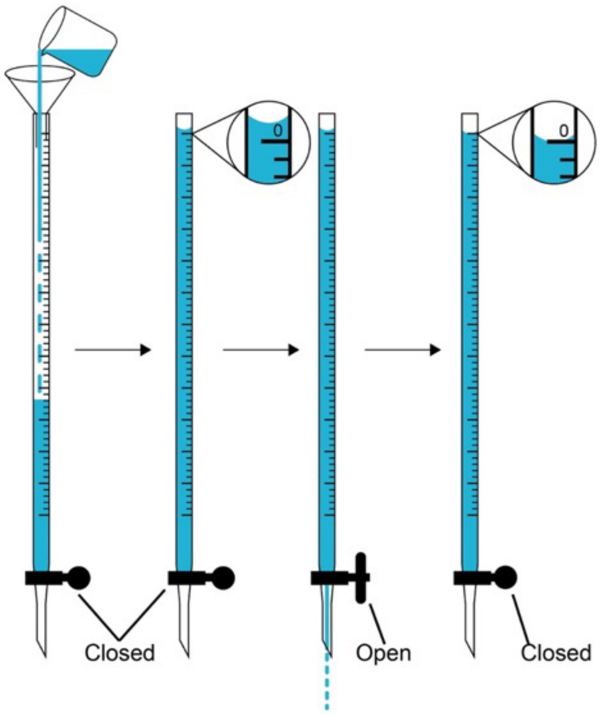
Avoid skin contact with iodine solution as it will stain the skin.

To do

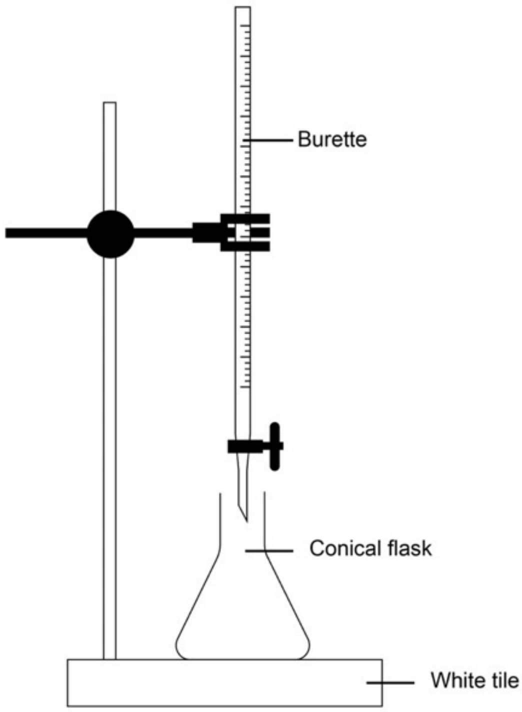
1. Measure a 100 cm^3 sample of juice into a conical flask. Add 1 cm^3 starch solution. Stir well.

2. Collect some iodine solution in a 100 cm^3 beaker. Carefully, fill the burette to the 0 cm^3 line with iodine solution, using a funnel, taking care to avoid skin contact. You may need to place the burette stand on a stool to see the fill line clearly at eye level.

You will need to refill the burette to 0 cm^3 every time you use it.

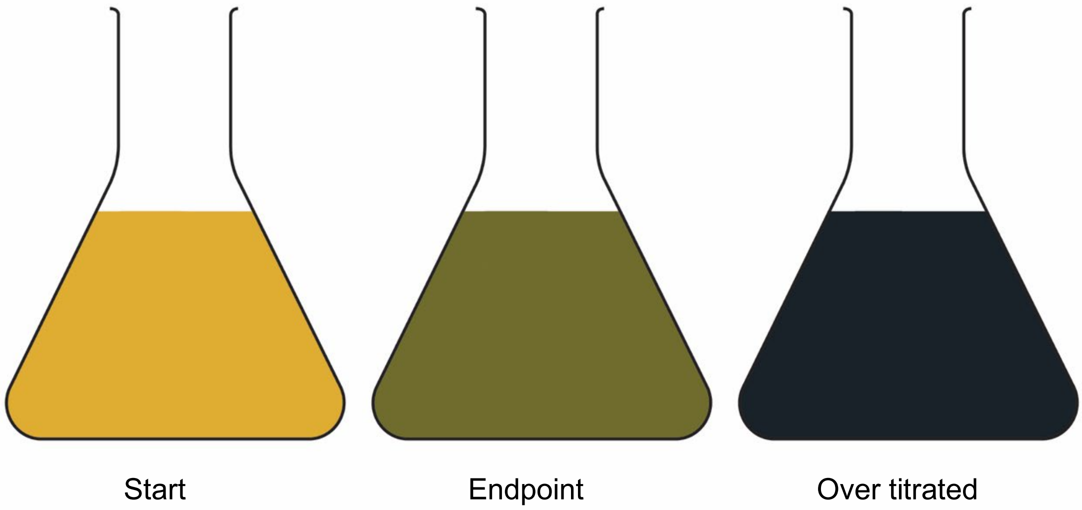


3. Place the conical flask on top of the white tile, below the burette, as shown in the diagram.



4. Carefully and slowly add the iodine solution to the conical flask. Swirl the flask well after each addition.

5. Continue to add small amounts of iodine to the conical flask until the endpoint. This will be difficult to spot due to the colour of the juice – you should look for a dirty green colour and specks of black solid forming.



6. Carefully read the volume of iodine used from the burette. Record this in the table in your workbook in the trial run column.

7. Now you know approximately when the endpoint will be reached, you can be more accurate in the next repeat. As you get close to the expected endpoint, slow the rate at which the iodine is added by turning the burette tap so the iodine is added dropwise.

8. Repeat the procedure until you have three titres that agree to within +/– $0.1\ cm^3$. You can reuse the conical flask as long as you rinse it out well with distilled water each time.

Activity 3: finding the iron content of food

Safety and hazards

- Always wear safety glasses when instructed to.
- Take care to not drop the cuvette (tube).
- The solutions of iron(III) chloride ($FeCl_3$) are harmful and corrosive. Handle these solutions with care to avoid skin contact.

Irritant

Corrosive

Equipment

5 × labelled standard solutions of iron(III) chloride ($FeCl_3$) labelled 1–5.

Potassium thiocyanate ($KSCN$) solution

3 × food extract solutions (broccoli, spinach, peas)

Distilled water

5 × cuvettes

5 × teat pipettes

Automatic pipette

Spectrophotometer

Ruler

To do

1. Read through the guide to using an automatic pipette at the end of this method.

2. Check that your automatic pipette is set to 5 cm^3. If it isn't, ask for help.

3. Use the automatic pipette to add 5 cm^3 potassium thiocyanate to each of the 100 cm^3 of the five standard solutions of iron(III) chloride. You should see a faint pink colour. Wear eye protection and be careful to avoid contact with skin when measuring the $FeCl_3$ solutions. ≥ 1.5 M $FeCl_3$ solutions are also harmful if ingested.

Note: if automatic pipettes are not available, use a 5 cm^3 plastic pipette instead.

To draw a calibration curve

Note: as different models of spectrophotometers can vary in their operation, please make sure that you are familiar with the model you are using and follow all instructions provided.

1. Make sure the spectrophotometer reads 480 nm. If it does not, ask for help from your teacher. A control (blank) cuvette should already be in the correct position.
2. Shut the lid.
3. Take a blank measurement.
4. The reading should be close to 0. Record the exact reading in the results table in your student workbook.
5. Use a teat pipette to fill a clean cuvette to the line/arrow with solution 1.
6. Lift the lid of the spectrophotometer and place a cuvette into the correct space. (Make sure the opaque side is facing the middle and the clear side is facing the front.)
7. Take a reading from the solution and record this in your results table.
8. Repeat steps 1–7 using solutions 2–5.
9. Plot the results on the graph paper in your workbook and draw a calibration curve with a ruler.

To analyse iron content in a range of foods

1. Choose a solution extracted from a foodstuff ($KSCN$ is already added to these).
2. Fill a cuvette with the extract up to the line/arrow.
3. Place the cuvette in space 1 of the spectrophotometer. Close the lid.
4. Press button 1 on the green dial.
5. Note the reading in the results table in your workbook
6. Use your calibration curve to determine the concentration of iron in the food.
7. Repeat with the other food extracts.

Using an automatic pipette

Equipment

- Automatic pipette set to 5000 μl (5 cm^3)
- Clean pipette tips
- Solution of complexing agent
- Standard and sample solutions

Method

1. Check that the automatic pipette is set to 5 ml (5 cm^3). Do not adjust the setting.
2. Add a clean pipette tip.
3. Press the button to the first stop.
4. Insert the tip into the liquid.
5. Slowly release the button. The correct volume of liquid is automatically collected.
6. Transfer the liquid to the beaker containing the standard solution.
7. Gently press the button into the second stop position. The liquid is automatically dispensed.
8. Repeat steps 1–7 for all standards and samples. The tips can be reused in the same solution but you must change the tip when measuring out a new solution.
9. Press the eject button to release the tip before placing the pipette down onto the bench.
10. Keep new and used tips separate and dispose of used tips in general waste.