

Student's document

COLOURFUL EVIDENCE: Identifying colouring agents in food

The labels on food products must list any additives. Food colourings are one group of additives. Only certain ones are allowed and only in certain amounts. The European Food Safety Authority (EFSA) collaborates with national authorities to provide independent scientific advice about food safety. In December 2006, it called for data on food colours as part of a re-evaluation of all authorised food additives in the EU.

In the UK the Food Safety Act 1990 protects consumers and fair traders. It is enforced by Local Authorities. Typically, Environmental Health Officers and Trading Standards Officers collect samples for analysis by Public Analysts. The work of these analysts may end up as evidence in a court of law.

Your brief

You will work in a group. The group will be given:

- solutions of pure food colourings and two reference mixtures of food colourings
- commercial food colourings
- samples of colourings extracted from food products.

Your brief is to:

- use thin layer chromatography (TLC) to identify colourings extracted from food products, checking them against what the packaging says
- write a statement to be read out in a court of law saying what evidence you have that some of the food products tested contained the wrong ingredients compared to those listed on the packaging.

Your investigation

The group's tasks are to run chromatograms of:

- the reference mixtures to identify which spots match which food colourings
- commercial food colouring mixtures to confirm the colourings listed on the labels are present
- food colourings extracted from confectionery products to find out if:
 - the food colourings stated on the packaging are present
 - any food colourings not given on the packaging are present.

Decide which analysis or analyses each member in the group will do. Use

Student sheet: *Planning grid* to show who does what.

A risk assessment must be carried out before starting practical work.

Task 1

Using **Student sheet:** *Standard procedure for TLC of food colourings*, carry out TLC on the two reference mixtures:

- Reference mixture A containing Tartrazine, Sunset Yellow and Carmoisine
 - Reference mixture B containing Ponceau 4R, Brilliant Blue FCF and Green S.
- Run each reference mixture alongside solutions of the pure food colourings in it. Identify which spot corresponds to which food colouring. You will use these two reference mixtures to identify the food colourings in food products.

Task 2

Using **Student sheet:** *Standard procedure for TLC of food colourings*, carry out TLC on:

- each of the commercial food colouring solutions you are given, running them alongside the two reference mixtures
- the food colourings you are given that were extracted from the confectionery samples. Again, run them alongside the two reference mixtures.

Student sheet: *Products composition* gives the ingredients listed on the packaging of the food products you have been asked to analyse.

For tasks 1 and 2 you could take photographs of the chromatograms to include as an appendix to your court statement (as an item of evidence).

Task 3

Each member should summarise the group's results (use **Student sheet:** *Reporting form*) and write a statement to be read out in a court of law explaining which of the extracted samples gave you cause for concern.

Your teacher will tell you when the analyses are to be carried out. You need to collect the apparatus and chemicals needed and set out your work area. Remember that a risk assessment must have been carried out before you start work.

To find watchdog organisations try these websites:

- European Food Safety Authority: http://www.efsa.europa.eu/en/about_efsa.html
- Food Standards Agency: <http://www.food.gov.uk/> and <http://www.eatwell.gov.uk/foodlabels/understandingnumbers/>
- The Association of Public Analysts: <http://www.the-apa.co.uk/>
- List of UK laboratories: <http://www.the-apa.co.uk/Laboratories/index.html>

Use your favourite search engine to find out about food colouring and other food additives. Much information is factual, for example, types of additives and assigned E-numbers. Be wary though. Some sites are biased about the use of food additives – for and against. Make sure you check enough sites to get a balanced view.

Your findings

Write your results and conclusions on the 'Reporting form' you have been given. Use this data to write your statement to be read in court. It needs to explain, with supporting evidence (e.g. photographs of the chromatograms), which confectionery samples gave cause for concern.

Compare the group's results with data given on the 'Products composition' datasheet. For each chromatogram you run, calculate and record the R_f values for each spot.

Student self assessment

This activity was about using scientific knowledge and understanding to solve problems, working in teams to solve problems and communicating scientific results. For each case, write about 50-100 words explaining:

- what scientific skills and knowledge you used and how effectively you used them.

- how you worked as a team, giving examples of how you supported others in your group or were supported by them
- how effective you think your statement might be in a court of law given that it would be heard by people who might not have a science background.

You may decide to use alternative forms of self assessment

Student sheet: Standard procedure for TLC of food colourings

Scope

This method may be used for aqueous solutions of food colourings. The solution should not contain significant quantities of other solutes such as sugars.

Principle

Food colourings present in solution are separated using thin layer chromatography. Cellulose-coated plastic backed TLC sheets may be used. Water is an effective eluting solvent, but others may be tried. Specimens under examination are compared with standard samples. The coloured spots are easily visible and the intensity of colour allows quite low concentrations to be recognised.

Apparatus

Equipment

- glass capillary tubes
- chromatography tank and lid
- TLC plate - cellulose on glass or plastic (10 cm x 5 cm).

Materials

- six solutions of pure food colourings:
 - Tartrazine
 - Sunset Yellow
 - Carmoisine
 - Ponceau 4R
 - Brilliant Blue FCF
 - Green S
- two reference mixtures: Reference mixture A (Tartrazine, Sunset Yellow and Carmoisine) and Reference mixture B (Ponceau 4R, Brilliant Blue FCF and Green S)
- samples of commercial food colouring products containing one or more of the colourings listed above
- samples of food colourings extracted from confectionery products
- distilled water

Procedure

Remember, a risk assessment must be carried out before starting work. Work with care. Keep equipment, including the TLC plates, clean. Hold the TLC plates at their top corners. Only lay them down clean sheets of paper.

- 1 Pour distilled water into the chromatography tank to a depth of about 5 mm. Cover with a lid and leave while you prepare the TLC plates.
- 2 Mark the TLC plate using a soft lead pencil. Draw a baseline 1 cm from the bottom of the plate. Mark the positions where the spots will be applied and label them (again using a soft lead pencil. Leave at least 1 cm between spots.
- 3 Spot the solutions being examine. Dip a clean capillary tube into the solution being tested and apply a small drop to the plate. Use a new, clean capillary tube for each solution. Allow spots to dry.
Note: if necessary, practice on a piece of filter paper until you can produce spots not more than 0.3 cm in diameter.
- 4 Place the plate in the TLC tank. Do this carefully to avoid the water splashing around. Leave until the water front reaches about 2 cm from the top of the plate.

- 5 Remove the TLC plate from the tank. Lay the plate on a clean piece of paper. Mark the position of the water front and leave the plate until it has dried. At this stage you may wish to take a photograph of the chromatogram.

Calculations

Record the identities of the separated spots. For each spot of food colouring, calculate its retention value, R_f , using:

$$R_f = \frac{\text{distance moved from the baseline by the food colouring}}{\text{distance moved from the baseline by the water front}}$$

Take the position of each spot from its centre.

Expression of results

For each chromatogram run, record the identity and R_f value for any spots observed.

Student sheet: Planning grid

Use the pictures of blank TLC plates to plan your work. In each case write the name of the group member responsible for running the chromatogram and list the samples to be spotted, including their positions on the baseline.

[illegible]

Student sheet: Products composition

Food product	Food colourings found in products					
	Tartrazine	Sunset Yellow	Carmoisine	Ponceau 4R	Brilliant Blue FCF	Green S
Langdale Blue			✓		✓	
Langdale Green	✓				✓	
Langdale Scarlet		✓		✓		
Langdale Yellow	✓	✓				
SuperCook Blue			✓		✓	
SuperCook Green	✓					✓
Extract from confectionery A		✓		✓		
Extract from confectionery B	✓		✓		✓	
Extract from confectionery C	✓		✓		✓	✓
Extract from confectionery D		✓		✓	✓	
Extract from confectionery E	✓				✓	✓
Extract from confectionery F	✓				✓	✓

Student sheet: Reporting form

Indicate clearly which analyses you carried out and which ones were done by other members of your group (note: you may want to stick your chromatograms to the back of this reporting form or on a separate sheet of paper)

Sample	Food colourings found to be present	Food colourings listed on packaging	Comments