Objectives

B1.13B *Investigate the use of chemical reagents to identify starch, reducing sugars, proteins and fats.*

B1.14B Explain how the energy contained in food can be measured using calorimetry.

Maths requirements

1a Recognise and use expressions in decimal form.

2c Construct and interpret frequency tables and diagrams, bar charts and histograms.

3c Substitute numerical values into algebraic equations using appropriate units for physical quantities.

Learning outcomes

5th **SB1.13B** Describe how to test for starch in food.

5th **SB1.13B** Describe how to test for reducing sugars in food.

5th **SB1.13B** Describe how to test for proteins in food.

5th **SB1.13B** Describe how to test for lipids in food.

7th **SB1.14B** Explain how calorimetry can be used to measure the energy in food.

8th **SB1.14B** Evaluate calorimetry tests for accuracy.

Exploring

1. Identifying substances in foods

This practical forms part of the core practical requirement of the specification. It is supported by the information on Students' sheet CP3 (Testing food). There are several different tests that students can use for testing some of the substances in foods. These, with preferred methods given first, include:

- starch: solution of iodine in potassium iodide (qualitative)
- lipid: ethanol/emulsion (qualitative), smear test (qualitative), Sudan III (qualitative)
- reducing sugars: Benedict's test (semi-quantitative), Clinistix® (glucose, semi-quantitative)
- protein: biuret test (semi-quantitative), Albustix® (semi-quantitative, only for some proteins).

Any semi-quantitative test can also be used qualitatively. Worksheet SB1f.1 guides students in using the iodine test, emulsion test, Benedict's test and biuret test. These could be replaced with others if they are more appropriate to your students.

The practical work is most simply carried out on powdered foods, such as powdered potato, full and/or low fat powdered milk, whey (protein) powder, powdered egg white (use commercially available albumen) and powdered glucose. You could also include icing sugar if you want to show that sucrose is non-reducing. Label each powder as 'food A', 'food B' etc. and ask students to identify which is which from a list of names, using their results.

An alternative to a water bath for the Benedict's test is a large beaker of water heated to boiling, before turning off the heat source. Tubes should be placed in the water while it is still very hot.

Biuret solution does not keep, so only prepare as much as is needed.

⚠ Safety

Remind students that they should not taste any of the foods. Care should be taken with very hot water, to avoid scalding.

Support: Name each powder with its correct food name, and ask students to predict how each will respond to the tests before carrying them out. They should record their predictions in a table for comparison with the actual results.

Stretch: If using icing sugar, after students have produced a negative test for reducing sugar, you could show them how to hydrolyse the sugar by adding dilute hydrochloric acid (about half as much as the volume of tube contents) and placing the tube in a boiling water bath for about 10 minutes. After the tube has cooled, add some dilute sodium hydrogencarbonate solution until the fizzing stops, then repeat the Benedict's test on the mixture.

Challenge students to adapt one of the tests to make it more quantitative. If needed, suggest the idea of testing solutions of known concentration of a substance. (This is covered further in Explaining 2.)

Expected results

The results of the tests will depend on the foods used. The table below shows results from the suggested foods. Note that using coloured foods may make some colour changes more difficult to see.

Food	Iodine test	Benedict's test	Biuret test	Emulsion test
full-fat milk	yellow–orange	yellow	purple	cloudy
whey	yellow–orange	bright blue	purple	clear
egg white	yellow–orange	bright blue	purple	clear
potato	black–blue	bright blue	light blue	clear
glucose	yellow–orange	red precipitate	light blue	clear
(icing sugar)	yellow–orange	bright blue	light blue	clear

Errors are most likely to occur if equipment is not cleaned properly between tests and it becomes contaminated with another sample.

Course resources :
*Bio Students' sheet CP*3

Equipment (per student or group)

eye protection, food samples – powdered potato, full and/or low-fat powdered milk, whey (protein) powder, powdered egg white (use commercially available albumen), powdered glucose – water, measuring cylinder, spatula, paper towels, test tubes, racks and bungs, stirrer, iodine solution (1 g iodine in 100 cm^3 0.5 mol dm^{-3} potassium iodide solution) in dropper bottle, Benedict's solution (prepared according to CLEAPSS Recipe sheet 11 (qualitative) or 12 (for quantitative measurements)), 5% potassium hydroxide and 1% copper sulfate solution or biuret solution (prepared according to CLEAPSS Recipe sheet 15) in dropper bottle, absolute ethanol, water bath at 95–100 °C

Optional: icing sugar, dilute hydrochloric acid (approximately 0.1 mol dm^{-3}), dilute sodium hydroxide solution (approximately 0.1 mol dm^{-3}), water bath at 100 °C, Sudan III stain (dissolve 0.5 g dye in 70 cm^3 ethanol (highly flammable) and 30 cm^3 water, using a warm water bath and filter) in dropper bottle