

Food tests

investigate food samples for the presence of glucose, starch, protein and fat

For Pearson Edexcel International GCSE Biology 4BI1 and Science (Double Award) 4SD0. Teacher answers start on a new page.

Name

Date

Aim

To use chemical reagents to test food samples for glucose, starch, protein and fat.

Background

Foods contain different **biological molecules**. Each of the four tested here reacts with a particular reagent to give a colour change that you can see, so you can identify what a food contains without any complicated equipment.

The tests are **qualitative**: they show whether a molecule is present, not exactly how much. For a negative result the reagent keeps its original colour, so you need to know both the start colour and the positive result.

Glucose is a **reducing sugar**, so it is detected with Benedict's solution after heating. Starch is detected with iodine solution, protein with biuret reagent, and fat with ethanol. Fat does not dissolve in water, so the ethanol test works by making tiny droplets of fat that scatter light.

Equipment

- Food samples: glucose solution, starch suspension, egg white (diluted with water), vegetable oil, crushed peanut or other unknown food
- Pestle and mortar or glass rod, and distilled water, to crush solid foods and mix them with water
- Benedict's solution with a dropping pipette
- Iodine solution with a dropping pipette
- Biuret reagent (or dilute sodium hydroxide solution and dilute copper(II) sulfate solution) with a dropping pipette
- Ethanol, about 2 cm³ per test, and a test tube of distilled water
- Test tubes (four for each food sample, plus four for the distilled water control) and test tube racks
- Beaker (250 cm³) of hot water from a kettle as a water bath at about 80–90 °C, and a test tube holder
- 10 cm³ measuring cylinder or labelled plastic dropping pipettes
- Eye protection and a marker pen

Risk assessment

Hazard	Risk	Precaution
Hot water from the kettle or water bath	Scalds from spills or from handling hot tubes	Fill the beaker no more than half full, stand it on a heatproof mat, hold tubes with a test tube holder and point them away from people.
Ethanol	Highly flammable liquid and vapour; irritates eyes	Use hot water from a kettle, not a Bunsen burner, for the water bath; keep the ethanol bottle closed and away from the kettle; use only about 2 cm ³ ; wear eye protection.
Benedict's solution, iodine solution and biuret reagent	Irritant to eyes and skin; iodine stains skin and clothes; biuret reagent contains alkali	Wear eye protection; wash splashes off skin with plenty of water; clear spills straight away.
Peanut or other food samples	Allergic reaction in someone with a nut allergy	Check that no one in the class has a food allergy; do not taste or eat any sample.

Method

1. Label one clean test tube for each test on each food sample, and put on your eye protection.
2. Test distilled water with each of the four reagents first, as a negative control, so you know the colour of a negative result.
3. If the food is a solid, crush a small piece with a little distilled water in a mortar and mix well. Use the liquid for the tests for glucose, starch and protein.
4. Benedict's test (glucose): put about 2 cm³ of the food liquid into a test tube and add about 2 cm³ of Benedict's solution.
5. Stand the tube in the hot water bath (80–90 °C) for about 3–5 minutes. Record the final colour.
6. Iodine test (starch): put about 2 cm³ of the food liquid into a clean test tube and add 3–4 drops of iodine solution. Shake gently and record the colour.
7. Biuret test (protein): put about 2 cm³ of the food liquid into a clean test tube and add 2 cm³ of biuret reagent. Mix gently and record the colour after about a minute.
8. Ethanol test (fat): put a small piece of the food (or 2–3 drops of oil) in a dry test tube and add about 2 cm³ of ethanol. Shake well for about a minute.
9. Allow any solid to settle, then pour the ethanol into a second tube containing about 2 cm³ of distilled water. Record whether the mixture stays clear or turns cloudy white.
10. Repeat all four tests on each of the other food samples, using clean tubes and a clean pipette each time.
11. Decide which of glucose, starch, protein and fat each food contains, and complete the results table.
12. Tip all test mixtures into the waste container as directed by your teacher and wash your hands.

Results

Results of the food tests					
Food sample	Benedict's solution (colour)	Iodine solution (colour)	Biuret reagent (colour)	Ethanol then water (clear or cloudy)	Nutrients present
Distilled water (control)					
Glucose solution					
Starch suspension					
Egg white					
Vegetable oil					
Unknown food					

Exam questions 9 questions · 26 marks

1

State the reagent used to test for starch and the colour it turns if starch is present.

[2 marks]

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2

A student heats a test tube of Benedict's solution and food in a water bath rather than over a Bunsen burner flame. Give two safety reasons for doing this.

[2 marks]

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3

Describe how the ethanol test is used to show that a food contains fat.

[3 marks]

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- 4** Three foods, P, Q and R, were tested. The results are shown in the table. State the biological molecules found in each food. **[3 marks]**

Results for foods P, Q and R				
Food	Benedict's solution	Iodine solution	Biuret reagent	Ethanol then water
P	Blue	Blue-black	Purple	Clear
Q	Orange	Orange-brown	Blue	Clear
R	Blue	Orange-brown	Purple	Cloudy white

- 5** A student tested a food with biuret reagent and the solution stayed blue. State what this result shows and how the student could check that the biuret reagent was working. **[2 marks]**

- 6** Explain why a solid food is crushed and mixed with water before it is tested for glucose, starch and protein. **[2 marks]**

- 7** After heating with Benedict's solution, one sample turned green and another turned brick-red. Explain what this shows about the two samples. **[2 marks]**

8 A student wants to compare the amount of reducing sugar in three fruit juices using Benedict's solution. Suggest how the student could make the comparison fairer and more reliable. **[4 marks]**

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9 Describe how you would test an unknown food sample to find out whether it contains glucose, starch, protein and fat. Include the safety precautions you would take. **[6 marks]**

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Teacher answers

Practical 1: Food tests. The example results are practice data, not real measurements.

Example results

Example results (practice data)					
Food sample	Benedict's solution (colour)	Iodine solution (colour)	Biuret reagent (colour)	Ethanol then water (clear or cloudy)	Nutrients present
Distilled water (control)	Blue	Orange-brown	Blue	Clear	None
Glucose solution	Brick-red	Orange-brown	Blue	Clear	Glucose
Starch suspension	Blue	Blue-black	Blue	Clear	Starch
Egg white	Blue	Orange-brown	Purple	Clear	Protein
Vegetable oil	Blue	Orange-brown	Blue	Cloudy white	Fat
Crushed peanut	Blue	Orange-brown	Purple	Cloudy white	Protein and fat

Conclusion

Each reagent only changed colour for the molecule it tests for. Glucose gave a brick-red colour with Benedict's solution, starch turned iodine blue-black, egg white turned biuret reagent purple and oil formed a cloudy white emulsion in water. Fat is not soluble in water but dissolves in ethanol; when the ethanol is poured into water the fat comes out of solution as tiny droplets that scatter light and make the mixture look cloudy. The peanut contains protein and fat but no detectable glucose or starch. The distilled water control stayed the start colour in every test, so the colour changes were caused by the food and not the reagent.

Errors and improvements

Error	Effect on the results	Improvement
Colours are judged by eye, so different students may describe the same colour differently (for example orange or brick-red)	The amount of reducing sugar can be wrongly estimated, and a weak positive may be missed	Compare with a set of colour standards made from known glucose solutions, or use a colorimeter, and always state the colour seen.
Cross-contamination from reusing tubes or pipettes	False positive results, for example starch appearing in a glucose sample	Use clean, labelled tubes and a separate pipette for each food and reagent.
Benedict's mixture not heated for long enough or not hot enough	A weak or false negative for glucose	Keep the water bath at 80–90 °C and heat for the same time, at least 3 minutes, every time.
Solid food not crushed well or too little food used	Too few molecules dissolve to give a visible colour change	Grind with water until a liquid is formed and use the same volume of liquid each time.

Mark scheme

One mark for each point unless a maximum is given. Words in brackets are not needed for the mark.

1. [2]

- iodine (solution) (1) allow iodine in potassium iodide solution
- blue-black (1) allow black / dark blue; reject purple

2. [2]

- the liquid could boil / spit out of the tube and scald (1)
- the test tube could crack / break if heated directly in a flame (1)
- a water bath cannot go above 100 °C / heats the tube gently and evenly (1)
- no naked flame, so less risk of burns or of setting fire to clothes / hair (1)
- Max 2

3. [3]

- shake / mix the food with ethanol (1) allow dissolve the food in ethanol
- pour the ethanol (layer) into water / add water (1)
- a cloudy / milky white emulsion forms if fat is present (1) ignore precipitate; reject a colour change such as blue or purple

4. [3]

- P: starch and protein (1) both needed
- Q: glucose (1) allow reducing sugar
- R: protein and fat (1) both needed; allow lipid for fat

5. [2]

- (the food contains) no protein / protein not present (1) allow too little protein to detect
- test a food known to contain protein, such as egg white, with the same reagent and see it turn purple (1) allow use a positive control; ignore test with another reagent

6. [2]

- so the molecules dissolve / are released into the liquid (1) allow increases surface area
- so they can react with the reagent (1)

7. [2]

- both contain glucose / reducing sugar (1)
- the brick-red sample contains more glucose / the green sample contains less (1) ignore references to other nutrients

8. [4]

- use the same volume of each juice (1)
- use the same volume of Benedict's solution (1)
- heat in the same water bath at the same temperature for the same time (1)
- compare the colours with colour standards made from known glucose concentrations / use a colorimeter (1)
- repeat the test on each juice and check the results agree (1)
- Max 4

9. [6]

Level 3 5-6	A full description of all four tests, with reagents, quantities or conditions and the positive colour for each, and at least one relevant safety precaution; the answer is logical and clear
Level 2 3-4	Describes at least three tests with reagents and positive results, or all four tests with some detail missing; a safety precaution may be missing
Level 1 1-2	Names some reagents or gives some positive results with little detail of the method

Indicative content

- crush the food with water and filter or use the liquid; Benedict's solution: add and heat in a water bath, blue to green / yellow / orange / brick-red for glucose; iodine: add drops, orange-brown to blue-black for starch; biuret reagent: add and mix, blue to purple for protein; ethanol: shake the food with ethanol, pour into water, cloudy white emulsion for fat; precautions: eye protection, ethanol away from flames, hot water bath handled with care; use a negative control or clean tubes

Exam tips

- Learn the start colour as well as the positive colour for every test. For a negative result give the colour, for example 'stays blue', not just 'no change'.
- Write 'blue-black' for starch ('purple' is rejected), and 'orange' or 'brick-red' for a strong Benedict's result.
- Benedict's solution must be heated in a water bath. Say this in method questions, together with the colour sequence blue, green, yellow, orange, brick-red.
- The ethanol test result is a cloudy white emulsion. A colour change is not expected, so do not write one.
- Safety marks are usually for eye protection and keeping ethanol away from flames. Be specific about the hazard.