

Feeding a growing world: Potato variations

Technician notes

Aim

The Earth's resources are limited, but the human population is growing fast. How can we ensure food security – adequate safe, healthy food – for everyone?

Potatoes are a staple food but may not always be completely safe. Acrylamide is a carcinogen found in potatoes that have been heated to temperatures above 120 °C, for example in the preparation of chips or potato crisps. It is created in the Maillard reaction between reducing sugars and the amino acid asparagine in the potato. A test for reducing sugars in potatoes will tell us which varieties of potato are likely to produce the least acrylamide when cooked at high temperatures.

Investigation: Potato reducing-sugar content



Planning

Two potatoes (or at least 100 g of each potato, cut immediately before the lesson begins) of different varieties are required per pair of students, but five or six varieties should be used so that students can pool their results after testing. Suggested varieties are: King Edward, Wilja, Desiree, Whites, Maris Piper, Maris Peer, Charlotte, Estima, Rooster, Marfona, Vivaldi, Mozart. Store them in a cool, dark, dry place, but **not** in the fridge. Do not use green potatoes.

You will need to prepare the Benedict's reagent and standards shortly before the lesson. If you do not have time to prepare the standards that day, you can make them in advance and photograph each of them in good light against a white background, then laminate the labelled photographs to make a comparison chart.



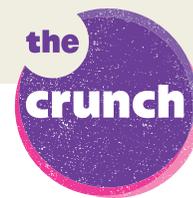
Safety

Teacher: Carry out a risk assessment with the students. Ask what hazards they can predict and how to control them.

Technician: Refer to hazard information for reagents – Benedict's reagent, glucose test strips. CLEAPSS Hazcards 27C (copper salts) and 91 (NaOH) are relevant to preparation of Benedict's reagent. In Scotland see the entry for Benedict's reagent in the SSERC Hazardous Chemicals Database. Wear eye protection when preparing and using Benedict's reagent.

Avoid touching the coloured areas of test strips; they may contain hazardous chemicals.

If a centrifuge is used, make sure learners know how to use it, including balancing the tubes. Centrifuges should conform to CLEAPSS/SSERC safety standards and have a lock or automatically cut off power to the rotor when the lid is raised. If the centrifuge does not have a lock, make sure that a notice is clearly visible warning students not to lift the lid until they hear that the rotor has stopped.



Equipment

Per pair of students:

From the kit:

- 2 × test strips for glucose (plus spares)
- 100 mL Benedict's reagent – in labelled dropper bottle

You will also need:

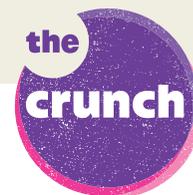
- 100 g each of two different potatoes (per pair of students), with five or six different varieties of potato available (class results will be combined); suitable suggested varieties: King Edward, Wilja, Desiree, Whites, Maris Piper, Maris Peer, Charlotte, Estima, Rooster, Marfona, Vivaldi, Mozart
- distilled water in wash bottle
- 2 × test tubes and rack
- 2 × sharp knives
- 2 × white tiles/plates/chopping boards
- 50 mL measuring cylinder
- 2 × 250 mL beakers
- 2 × 2 mL syringes
- pestle and mortar or access to suitable blender
- access to a balance
- muslin/old tights to strain mixture
- 4 × centrifuge tubes
- access to centrifuge, 3000 rpm (RCF g-force 1000 g) (optional)
- access to thermostatically controlled water bath set at 80 °C (labelled for scald hazard), or else Bunsen burner, beaker, tripod, gauze, thermometer
- access to standard solutions for comparison, made up from Benedict's reagent and glucose
- access to a colorimeter with red light source (optional)
- eye protection
- timer – a clock on the wall with a second hand, or stop clocks/stopwatches will be fine; students may use their own watches

Note that if no centrifuge is available students can use several layers of muslin or tights as a filter instead, so you may need to provide more cloth.

Preparation

Preparing Benedict's reagent

- To make up 1 dm³ (enough for 10 pairs of students), heat 800 mL distilled water and add 173 g sodium citrate and 100 g sodium carbonate. Make up to 850 mL with distilled water.
- Separately dissolve 17.3 g copper sulfate (CuSO₄·5H₂O) in 100 mL distilled water.
- Slowly pour the second solution into the first solution, while constantly stirring. Make up to 1 dm³ with distilled water.



Wear eye protection when preparing and using Benedict's reagent. This solution is described on the CLEAPSS Hazcard as low hazard. The copper sulfate solution is very dilute.

The preparation is described in CLEAPSS recipe sheet 11.

Preparing the standards for comparison in Benedict's test

This should be done just before the lesson. If it must be done a day or two before, the resulting standards can be photographed in good light against a white background and the colour photos mounted on board and laminated to make a comparison chart.

- Make up 100 mL 10% glucose solution in distilled water (10 g glucose in 100 mL distilled water; this is equivalent to a 0.56 mol dm^{-3} solution).
- Dilute this solution further to make a range of glucose solutions of 10%, 9%, 8% etc. to 1% and then from 0.9% to 0.1%, as described below.
- **To make dilutions:** take 50 mL of the 10% solution and pipette aliquots of it into separate graduated test-tubes or measuring cylinders as follows: 9 mL, 8 mL, 7 mL, 6 mL, 5 mL, 4 mL, 3 mL, 2 mL, 1 mL. Make each tube up to 10 mL with distilled water to give 9%, 8%, 7%, ... 1% solutions.
- Then take 5 mL from the 1% solution and pipette aliquots of it into separate graduated test tubes or measuring cylinders as follows: 0.9 mL, 0.8 mL, 0.7 mL, 0.6 mL, 0.5 mL, 0.4 mL, 0.3 mL, 0.2 mL, 0.1 mL. Make each tube up to 10 mL with distilled water to give 0.9%, 0.8%, 0.7%, ... 0.1% solutions.
- Place 2 mL of each glucose solution in a labelled test tube, add 2 mL Benedict's reagent and place in test-tube racks in a water bath at 80°C for 10 minutes.
- Remove the tubes in their racks from the water bath.
- These standards can be displayed so that students can use them for colour comparison to judge the concentration of reducing sugar in their potato extracts. Label them with % weight/volume and also in mg/dL to match the test strip labels: 10% w/v = 10 000 mg/dL, ... 0.1% w/v = 100 mg/dL.

Previous CLEAPSS Helpline reports have some further details (www.cleapss.org.uk).



Method

See the student activity sheet for a description.

