LABORATORY NOTES:

Food tests

Food testing is routinely carried out in senior biology classes. Students test a variety of food samples for carbohydrates, such as sugar and starch; lipids; proteins and vitamin C. These organic compounds react with specific chemical reagents to produce a visible and identifiable change.

Safety note:
Food or drink used in science laboratories must never be consumed as they may be contaminated.

A word of caution:
It is good practice to use the least hazardous test where available. Science ASSIST recommends the tests listed below as suitable for use in schools. There are, however, several food test methods that require the use of more hazardous chemicals, which should only be used following a site-specific risk assessment. There are some food testing procedures that are too hazardous and **must not** be used in schools. For example, Millon's reagent, which tests for proteins, contains mercury compounds. Biuret reagent is a much safer alternative.

Testing for vitamin C in foods

Vitamin C also known as L-ascorbic or ascorbic acid is a water-soluble vitamin. It is naturally present in a variety of fruits and vegetables and is also a dietary supplement. Sources include oranges, strawberries, red capsicums, blackcurrants, broccoli and Brussel sprouts. Vitamin C is also a reducing agent.

An indicator called DCPIP (2, 6-dichlorophenolindophenol) can be used to test for the presence of vitamin C in foods. DCPIP will change in colour from blue to red in the presence of an acid but loses its blue colour in the presence of vitamin C.

Materials:

- Food samples that contain vitamin C
- 0.1% ascorbic acid
- 0.1% DCPIP solution in a dropper bottle
- Test tubes
- Dropping pipette
- Deionised/distilled water

Method:

- Add 2mL of 0.1% DCPIP solution to a test tube.
- If using a liquid such as orange juice, add it drop by drop to the DCPIP solution in a test tube, mixing after each drop is added.
- When testing solid foods a liquid sample should be prepared by crushing the food in some deionised/distilled water and using only the liquid in the test procedure.
- Add the liquid sample drop by drop to the DCPIP solution in a test tube, mixing after each drop is added.
- The colour will change from blue to red if the sample is acid.
- Continue to add more of the test sample and if the colour of the DCPIP disappears then it shows that vitamin C is present.
- The 0.1% ascorbic acid is used as a positive control and a water sample as a negative control.
- This activity can be extended to utilise a titration method to determine the amount of vitamin C present in a food sample.

Testing for protein in foods

Gelatine is a protein derived from animal tissues such as skin and bone.

The Biuret test is used to detect the presence of peptide bonds in proteins. It can be carried out in several ways:

1. Addition of a Biuret reagent.
2. Addition of sodium hydroxide and copper sulfate solutions.

If protein is present, the solution turns from blue to purple due to the complexing of copper II ions with the peptide bonds in the protein sample. The more peptide-copper complexes that are formed, the deeper the purple colour.

Note: Test strips can also be used to detect some proteins. For example, Albustix or Uriscan.

A 1% w/v gelatine solution freshly prepared is generally used in the school science laboratory for a positive control. Deionised water can be used as a negative control.

Materials

- 1gm gelatine
- Biuret reagent or 2M sodium hydroxide and 1% w/v copper sulfate solutions
- 100mL deionised or distilled water
- Stirring rod
- Test tubes
- Electronic balance
- Spatula
- 1mL pipette

Preparation of a 1% w/v gelatine solution

- **Weigh out 1gm of gelatine powder.**
- **Add to 100mL of deionised/distilled water in a beaker.**
- **Warm to around 50˚C and stir to dissolve.**
- **Cool to room temperature before use.**

Method

- Add 1mL of the 1% w/v gelatine solution to a test tube.
- **Method 1:** Add 1 mL of the Biuret solution OR,
- **Method 2:** Add 0.5mL 2M sodium hydroxide solution followed by 0.5ml dropwise of the 1% w/v copper sulfate solution.
- For both methods mix and allow to stand for 5 minutes.
- Observe a colour change from blue to purple indicating the presence of protein.

Note: When testing foods, prepare a liquid sample by crushing the food in some deionised/distilled water and using only the liquid in the test procedure.

Testing for glucose (a reducing sugar) in foods

All monosaccharides and some disaccharides are reducing sugars. Some examples are glucose, fructose and lactose.

Benedict's solution is used to test for the presence of reducing sugars. The copper (II) ions present in Benedict's solution are reduced by these sugars to an insoluble brick-red copper (I) oxide, which precipitates. The blue colour will first turn green, then yellow and may finally form a brick-red precipitate. The amount of reducing sugars present can be related to the amount of precipitate formed. Test strips can be used to test solely for the presence of glucose.

A 1% w/v glucose solution freshly prepared is generally used in the school science laboratory for a positive control. Deionised water can be used as a negative control.

Materials

- 1g glucose powder
- Electronic balance
- Spatula
- Stirring rod
- 1mL pipette

Method 1: Test for glucose

- Test strips (such as Diastix, Clinistix, Uriscan or similar, available from pharmacies)

Method 2: Test for reducing sugars

- Benedict's solution in a dropper bottle
- 100mL deionised or distilled water
- Bunsen burner, tripod and gauze
- Test tubes
- 250mL beaker
- 400mL beaker half filled with tap water for use as a water bath

Preparation of a 1% w/v glucose solution

- **Weigh out 1gm of glucose powder.**
- **Add to 100mL of deionised/distilled water in a beaker.**
- **Stir to dissolve.**

Method 1

Follow the instructions for the test strips:

- Dip the test strip into the solution and wait the required time.
- Compare the colour chart with the test strips to determine the presence of glucose.

Note: The strips can be cut into half lengthways to obtain double the use.

Method 2

- Add 1mL of the 1% w/v glucose solution to a test tube.
- Add 1mL of Benedict's solution and mix.
- Place the test tube into a beaker containing boiling water.
- Boil gently for 2 minutes.
- Observe colour change and any precipitate formed.
- A brick-red precipitate indicates a positive result for the presence of a reducing sugar such as glucose.
- When testing solid foods for the presence of a reducing sugar add a small amount of the food into a test tube and cover with Benedict's reagent then heat gently for 2 minutes in a boiling water bath.

Testing for starch in foods

Starch is a complex carbohydrate found in a wide range of foods such as potatoes, rice, corn, pasta and grains. It is a mixture of the polysaccharides amylose and amylopectin, which vary in concentration depending on the type of starch used. Starch will produce a colloidal solution in water as it is not very soluble. Iodine solution is used to test foods for the presence of starch. If starch is present it will react with the iodine solution to produce a blue/black starch-iodine complex.

A 1% w/v starch solution is generally used in the school science laboratory for a positive control. The intensity of the colour produced when iodine solution is added is related to the concentration of the starch solution. The higher the concentration of the starch solution, the more intense blue/black complex is formed. The weaker the starch solution then a brown colour is produced. Deionised water can be used as a negative control.

It is best to prepare a fresh starch solution on the day that it is required as it deteriorates quickly.

Materials

- 1g starch (e.g. cornflour, potato flour or rice flour)
- 100mL deionised or distilled water
- Hot plate or Bunsen burner, tripod and gauze
- Electronic balance
- Spatula
- 250mL beaker
- 100mL measuring cylinder
- Stirring rod
- Test tubes or spotting tray
- Plastic Petri dish
- 1mL pipette
- Iodine solution (0.3% w/v iodine in 1.5% w/v potassium iodide) in a dropper bottle

Preparation of a 1% w/v starch solution

- **Prepare a smooth paste of 1gm of starch with a small volume (a few millilitres) of deionised/distilled water.**
- **Bring to the boil 100mL of deionised/distilled water.**
- **Add the starch paste to the boiling water and stir until dissolved. The solution will be cloudy in appearance.**
- **Allow to cool before use.**

Method

- Add 1mL of the 1% w/v starch solution to a test tube
- Add 2-3 drops of iodine solution
- A blue/black colour indicates a positive result (the formation of the starch-iodine complex).
- Alternatively, a few drops of the starch solution can be added to a well of a spotting tray and 1-2 drops of the iodine solution added.
- When testing solid foods for the presence of starch add a few drops of the iodine solution directly to the food in a plastic Petri dish.

Testing for the presence of lipids in foods

Lipids consist of fats and oils that are soluble in organic solvents, such as ethanol, but insoluble in water. Lipids are made up of fatty acids and glycerol. There are several ways to detect the presence of lipids in a food sample. Commonly used are the Ethanol Emulsion Test and Grease Spot Test.

A vegetable oil sample is generally used in a school science laboratory as a positive control. Deionised water can be used as a negative control.

Materials:

- Vegetable oil
- Food sample containing lipids, e.g. milk, cream, cheese or yoghurt

Method 1: Ethanol Emulsion Test

- Ethanol
- Pasteur pipette or dropper
- Test tubes
- Deionised/distilled water

Method 2: Grease Spot Test

- Brown paper bag strips approximately 10 x 5cm
- Cotton buds
- Light source such as a lamp
- Knife to cut solid pieces of food samples

Method 1:

- Combine 20 drops of the oil or liquid food sample with 2mL of ethanol in a test tube.
- Mix well. Allow to settle for 2 minutes to allow any lipid present to dissolve in the ethanol.
- Add 2mL of water directly to this tube and mix gently.
- If using a more solid food sample, first allow any particles to settle, then remove the clear liquid component into another test tube containing 2mL of water and mix gently.
- The solution will turn a cloudy white colour if lipids are present. Any lipids in the sample precipitate in the water forming an emulsion.
- Water can be used as a control. In this case no white emulsion is observed indicating there are no lipids present.

Method 2:

- For oil or liquid food samples apply a small amount to a cotton bud and swab directly onto a piece of brown paper bag.
- For more solid food expose a freshly cut surface and rub this on a piece of brown paper bag.
- Apply a water sample with a cotton bud to another piece of brown paper bag.
- Allow to dry for around 5 minutes.
- Hold the piece of paper bag up to a light source and look for a translucent spot that will indicate that lipids are present.
- If the sample applied evaporates without leaving a translucent spot then no lipids are present.

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