WELLCOME TRUST CENTRE FOR HUMAN GENETICS
UNIVERSITY OF OXFORD

KITCHEN ELECTROPHORESIS (30 min set-up, 1 h run)

Please read this protocol fully and take note of the precautions on the back before beginning.

APPARATUS

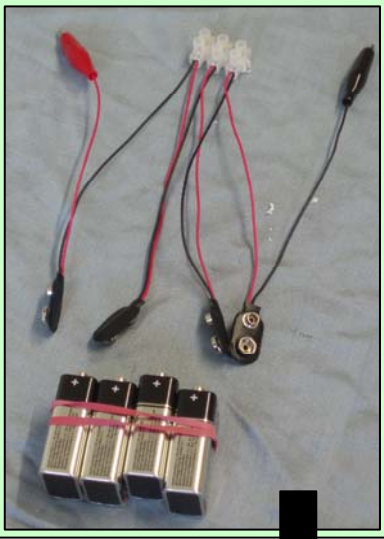
Sticky tape
Scissors
Aluminium foil
Food colouring/felt-tip pens
Bicarbonate of soda
250ml measuring jug
Teaspoon
Blu-tack
Chopping board or tray
Agar-agar powder (oriental supermarket)
Margarine tub – 1000 g or 500 g size (make sure it is a single moulded unit)
2 x Crocodile clips
4 x PP3 9v batteries
4 x PP3 battery connecters
4 x pieces of block connecter
Elastic band
Kitchen roll/tissue
Tweezers
Drinking straws

Margarine Tub Electrophoresis Chamber

- Tear off 2 pieces of foil and fold them to fit into the side of the tub from bottom to top. Secure in place by folding foil over the rim.

Battery Pack

- Use the connecter block to join the 4 leads red to black. (4 x 9V batteries in series = 36 V).
- Connect a crocodile clip to the free red lead and connect one to the free black lead.
- Hold the four batteries together with an elastic band.



Gel Comb

It is necessary to make small wells in the gel to place your samples.
Place up to 12 straws side by side with a small gap between them to form the teeth of the comb. The total width of the straw comb should be narrower than the long side of the margarine tub. Place a straw at right angles to the teeth and use sticky tape to stick them all together. Now stand the comb in the tub so that the teeth are down. Trim the teeth until the comb hangs on the sides of the tub with the ends of the straw teeth just off the bottom of the tub. Use blu-tack to block the ends of the teeth and stop the straws filling with gel. You could even try two combs in the tub about 3 cm apart to make two rows of wells.

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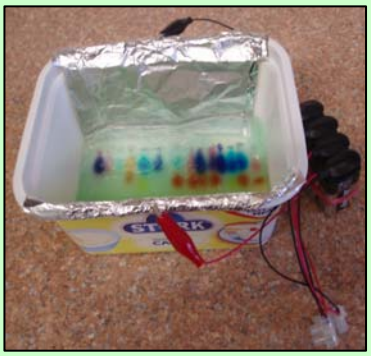
Preparing the Gel (0.5% gel in 0.25% bicarbonate of soda)

- Put ½ tsp (~1 g) of agar-agar powder in the small measuring jug.
- Add 200 ml of water and stir.
- Microwave the mixture on high for 1 min, then 3 min on low or until all the agar is dissolved: WATCH ALL THE TIME TO MAKE SURE THE SOLUTION DOES NOT BOIL OVER.
- Dissolve 1 tsp (~2.5 g) of bicarbonate of soda in 250 ml of cold water (10% solution). Stir until dissolved.
- Add 1 tsp (~2.5 ml) of this solution to the hot agar-agar solution.
- Stir the agar-agar, then pour 200 ml into the 1000 g margarine tub (or 100 ml into the 500 g tub).
- Stand the comb in the gel as shown about 3 cm from one end.
- When the gel has set (about 15 min), carefully remove the comb.

Preparing the samples

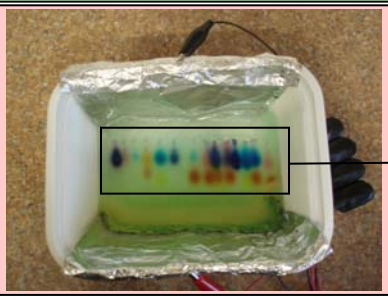
- Draw some small spots on some tissue with felt-pens or the food colour.
- Tear out a piece of the sample spot from the kitchen roll and roll it into a small ball and use tweezers to place it in a well in the gel.

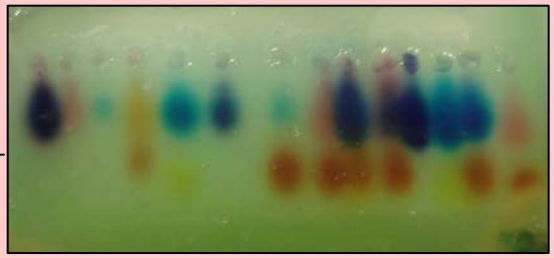
Running the gel



- Put 1 tsp (~2.5 ml) of the 10% bicarbonate solution into 200 ml cold water.
- Carefully pour this solution onto the gel away from the samples.
- Just add enough buffer to cover the gel to a depth of about 1cm.
- Connect the battery lead to the batteries
- Attach the crocodile clips to the foil electrodes at the rim of the margarine tub: Black lead (-ve terminal) to the sample end, and the red lead (+ve terminal) at the other end (DNA and dyes will move towards the +ve terminal).
- Leave for as long as you wish (1h is a good time).
- You should observe the dyes beginning to move after a few minutes.

Typical Results





Results of running 14 different coloured felt pens.

WHAT IS HAPPENING?

Electrophoresis relies on the principle that many chemicals are charged when dissolved in a salt solution. Here we are looking at dyes which have a net negative charge (DNA itself is a negatively charged ion). When a voltage is applied across the electrophoresis chamber the dyes (or DNA) will migrate toward the positive (anode) terminal of the batteries. The gel matrix provides some resistance which combined with the charge of the dyes and their molecular size, ultimately determines their speed at the applied voltage; smaller and/or higher charged molecules travel fastest.

In the laboratory we use special dyes to stain DNA, some of which are highly toxic and require ultra-violet light to see them. Unfortunately this step cannot easily be reproduced in the kitchen, but the demonstration here shows how we can separate a mixture of DNA molecules.

For more information Google 'Electrophoresis'.

PRECAUTIONS

DO NOT DRINK OR EAT THE SOLUTIONS OR GEL.
DO NOT USE ANY POWER SOURCE CONNECTED TO MAINS ELECTRICITY
TAKE CARE WHEN HANDLING THE HOT CONTAINER AND GEL SOLUTION
THIS STEP MAY REQUIRE THE HELP OF AN ADULT.