Experimental question

How does the concentration of ethanol affect the membrane permeability of beetroot?

Design

The cells of beetroot have red pigment in the vacuoles. When the membranes of the vacuole and the cell membrane are damaged by ethanol, a kind of alcohol, pigment will leak out. With this information, design an experiment to answer the experimental question.

1. What are the major components of a cell membrane?

   Phospholipid and protein (#8)

2. Which component will be dissolved by the ethanol? Explain your answer.

   Phospholipid, because both ethanol and phospholipid are polar in nature. (#8)

3. What will happen if cells of beetroot are immersed in ethanol?

   The membrane of the beetroot cells will be damaged. (#8)

4. What is the independent variable in this experiment?

   Concentration of ethanol. (#1)

5. What is the dependent variable of this experiment? How do you measure it?

   Permeability of cell membrane (#1)

   We can measure the colour intensity of the bathing solution after immersing the beetroot tissue into the ethanol (#2), the higher the intensity of the colour, the higher the permeability (#3)

6. State at least two controlled variables of this experiment to make it a fair test.

   Volume of ethanol, surface area of the beetroot, time for immersion (#12)

   Temperature of the environment, addition of beetroot tissue at the same time (#4)

7. What is the major assumptions underlying the whole experimental design?

   The colour intensity of the bathing solution is proportional to the permeability of membrane (#27)

Procedure to be handed out to students after completing the design.

Materials

Item Amount 1. Ethanol (15%, 30%, 50%) each 1 tube 2. Beetroot 1 pc 3. Razor blade 1 pc 4. Plastic chopping board 1 pc 5. Test-tube 4 pcs 6. Test-tube rack 1 pc 7. Stopper 4 pcs 8. Measuring cylinder (10 ml) 1 pc 9. Labels 4 pcs 10. Forceps 1 pc 11. Cork borer 1 pc 12. Beaker (250 ml) 1 pc 13. White paper 1 pc On side bench: (for the whole class)
13. Distilled water (in wash bottle)

Procedure

(Write down the steps necessary for performing the experiment. All quantities, e.g. volume of liquid used, amount of materials, time period for treatment, time taken in conducting the experiment, etc., are required to state clearly.)

1. Transfer 10 ml of distilled water, 15%, 30% and 50% of ethanol into each of 4 test tubes respectively. Label the tubes.
2. Using the same beetroot, prepare 4 cylinders of beetroot, each of 2 cm long, using cork borer and razor. Cut the cylinder of beetroot into four discs of the same thickness.
3. Rinse the cylinders of beetroot in running tap water until no pigment comes out from the damaged cells.
4. Randomly put 4 discs of beetroot into each of the test tubes prepared in step 1. Stopper the tubes.
5. Leave the tubes for 20 minutes. For every 5 minutes, shake the tube gently for a few seconds.
6. Take the cylinders of beetroot out from the test tubes using a pair of forceps.
7. Place the test tubes in front of a white paper. Record and compare the intensity of red colour of the solutions in the tubes with naked eyes.