WJEC Wales Biology A Level

SP 1.3b: Determination of solute potential by measuring the degree of incipient plasmolysis

Practical notes

Introduction

Incipient plasmolysis takes place when the **water potential** (Ψ) of a plant cell and that of its surrounding solution are equal (**isotonic** solution). In practice, this can be identified when **half** of the plant cells are plasmolysed.

At incipient plasmolysis, the Ψ of a cell is equal to its solute potential (Ψ_s) and the Ψ_s of the surrounding solution (**$\Psi_{cell} = \Psi_s = \Psi_s$ of surrounding solution**).

Equipment

- Red onion
- Sodium chloride solutions: 0.2, 0.4, 0.6, 0.8, mol dm^{-3}
- Distilled water
- Microscope
- 5× microscope slides
- 5× cover slips
- 5× Petri dishes
- 10 cm^3 measuring cylinder
- 5 pipettes
- Forceps
- Scalpel
- Ruler
- Paper towel
- Stopwatch

Risk assessment

Hazard	Risk	Precaution	Emergency
Broken glass	Cuts	Keep glassware away from the edge of the desk	Dispose of broken glassware carefully; elevate cuts and apply pressure; do not remove glass from cuts; seek medical assistance
Scalpel	Cuts	Direction of cut away from the body; do not attempt to change blade; keep scalpel away from the edge of the desk	Elevate cuts and apply pressure; wash minor cuts in cold water; seek medical assistance

Method

1. Label five **petri dishes** with 0.0, 0.2, 0.4, 0.6 and 0.8 mol dm^{-3}.
2. Place **10 cm^3** of the different sodium chloride solutions into the corresponding petri dishes (with distilled water in the 0.0 mol dm^{-3}).
3. Take a section of onion leaf and using **forceps**, remove a piece of the **epidermis** from the thin inner membrane.
4. Cut the epidermis into five **equal** pieces (8 × 8 mm) using a **scalpel.**
5. Use the forceps to gently place a piece of epidermal tissue into the solution in each Petri dish. Leave to equilibrate for **30 minutes** at **room temperature**.
6. After 30 minutes, transfer each piece of tissue onto a microscope slide. Carefully spread the tissue out and add **two drops** of sodium chloride solution of the **same concentration** using a pipette. Apply a cover slip.
7. Use a paper towel to absorb any **excess** solution on the microscope slide.
8. Place each slide under the clips on the microscope stage. Using the ×10 objective lens (and ×40 to enable closer observation) count the **total number of cells** in the sample and identify the **number of plasmolysed cells**. *Ensure that the same cell is not counted more than once by moving the slide in one direction only.*
9. Calculate the **% of plasmolysed cells**. Record your results (see below).
10. **Repeat** a further two times and calculate the **mean** % of plasmolysed cells.
11. Plot a **graph** of **mean % of plasmolysed cells** against **sodium chloride solution concentration**.
12. Read off the graph the concentration of sodium chloride solution (molarity) at which **50%** of the cells are **plasmolysed.**
13. Use this value and the data provided to **estimate** the solute potential.

Sodium chloride solution concentration (mol dm^{-3})	Solute potential (kPa)
0.05	-130
0.10	-260
0.15	-410
0.20	-540
0.25	-680
0.30	-860
0.35	-970
0.40	-1120

0.45	-1280
0.50	-1450
0.55	-1620
0.60	-1800
0.65	-1980
0.70	-2180
0.75	-2370
0.80	-2580

Variables

Independent variable

The variable that is **changed.**
i.e. the concentration of sodium chloride solution.

Dependent variable

The variable being **measured** whose value depends on the independent variable
i.e. the % of plasmolysed cells.

Controlled variables

The variables that are kept **constant** during the experiment:

- Size of epidermal tissue sample
  Controlled using a ruler and scalpel to cut sample pieces of 0.8 × 0.8 mm
- Volume of sodium chloride solution
  10 cm^3 measuring cylinder using to measure 10 cm^3 of each sodium chloride solution
- Length of time left in the sodium chloride solution
  Controlled using a stopwatch to time 30 minutes
- Temperature at which epidermal cells are left to equilibrate
  Room temperature
- Same type and age of onion
  Epidermal tissue should come from the same onion or same type of onion

Results

Sodium chloride concentration (mol dm^{-3})	Number of cells						% of plasmolysed cells			Mean % of plasmolysed cells
	Turgid			Plasmolysed						
	1	2	3	1	2	3	1	2	3	
0.0										
0.2										
0.4										
0.6										
0.8										