8 MEASUREMENT OF WATER POTENTIAL OF A PLANT TISSUE

8.1 INTRODUCTION

One of the important conditions for maintenance of the physiological active state of a plant is the favourable water balance. Water is an important constituent of a plant cell. It is the solvent for entry and transport of substances and for metabolic reactions, often a reactant itself. When the supply of water to the plant is inadequate, the development is reduced because all its vital functions proceed at reduced rate. Prolonged desiccation is lethal to an actively growing plant.

In Unit 11 (LSE-05) you have learnt about the physical principles that govern the net water fluxes from one cell to the next cell and the bulk movement of water in soil-plant atmospheric system. Water potential is the driving force which causes water to move in plant system.

The aim of this experiment is to determine the water potential of a plant tissue. This could be found out by placing uniform pieces of tissue of known weight and volume in a series of concentrations of sucrose solution and then determining in which of the solutions there will be no net movement of water in the tissue. This would happen if water potential of the external solution ψ_{we} is equal to the water potential of the tissue ψ_{wc}. In other words, the tissue will either gain or lose weight and volume due to differences in $\Delta\psi_w$ of external solution and the tissue.

It is also possible to know the water potential of a tissue by measuring only the decrease or increase in the length of the tissue instead of weight and volume. In this exercise you will determine water potential of potato tuber by placing the pieces in various concentrations of sucrose solution and then finding changes in length after a period of time.

8.2 MATERIALS REQUIRED

large firm potatoes

1 M sucrose solution

4 or 5 mm cork borer

12 wide mouth test tubes (15-20 ml) or 12 small beakers (50 ml)

glass rod

razor blade

graph paper

8.3 PROCEDURE

Take 12 test tubes and label them 1 to 6 and 1a to 6a. Arrange these two sets in a test tube rack. Obtain 100 ml of 1 M sucrose solution from your counsellor and dilute proper aliquots of this to make 0.15 M, 0.2 M, 0.25 M, 0.3 M, 0.35 M and 0.4 M sucrose as shown in the table on the next page.

1. Using a cork borer of approximately 0.5 mm diameter take out 12 cylinders from a single potato. Trim all to a uniform length of 4 cm with a razor blade. Wrap them in a moist paper towel or filter paper.
2. Lay each piece one by one on a graph paper and measure their length. As soon as you measure the length of a piece record it in the given table.

Test Tube No.	Amount of 1 M Sucrose in each tube	Distilled Water in each tube	Molarity
1 and 1a	3 ml	17	0.15 M
2 and 2a	4 ml	16	0.20 M
3 and 3a	5 ml	15	0.25 M
4 and 4a	6 ml	14	0.30 M
5 and 5a	7 ml	13	0.35 M
6 and 6a	8 ml	12	0.40 M

3. Cut it into 8 pieces of equal size and place them in test tube 1 containing sucrose solution. Repeat the procedure for the rest of the pieces (1 to 6 and 1a to 6a) and then leave them for 2 hours, occasionally shaking in between with a glass rod.
4. After two hours take out slices beginning with tube 1. Blot gently on filter paper, arrange them together lengthwise and measure the length on graph paper. Similarly measure the length of the pieces in other tubes in the same order in which you had initially placed them in the tubes.

8.4 RESULTS

Record your results in the table below:

No. of Tubes.	Molarity of Sucrose	Initial length X Xa	Change in length X Xa	Average of X and Xa	% of change in length.
1 and 1a	0.15				
and					
2 and 2a	0.20				
and					
3 and 3a	0.25				
and					
4 and 4a	0.30				
and					
5 and 5a	0.35				
and					
6 and 6a	0.40				

Calculate the percentage of change in length:

$$\% \text{ of change in length} = \frac{\text{Final length} - \text{Initial length}}{\text{Initial length}} \times 100$$

Plot percentage of change in length versus molarity of sucrose.

8.5 PRECAUTIONS

1. Try to measure sucrose aliquots very accurately.
2. Once you have cut the pieces of potatoes proceed without any delay and continue without any break till all pieces are in solution.
3. While measuring the length try to arrange cut pieces in the same sequence as they were chopped.

SAQ

1. In which sucrose concentration is the water potential of the tissue lowest?

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2. List the factors that affect the water potential is a given tissue.

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