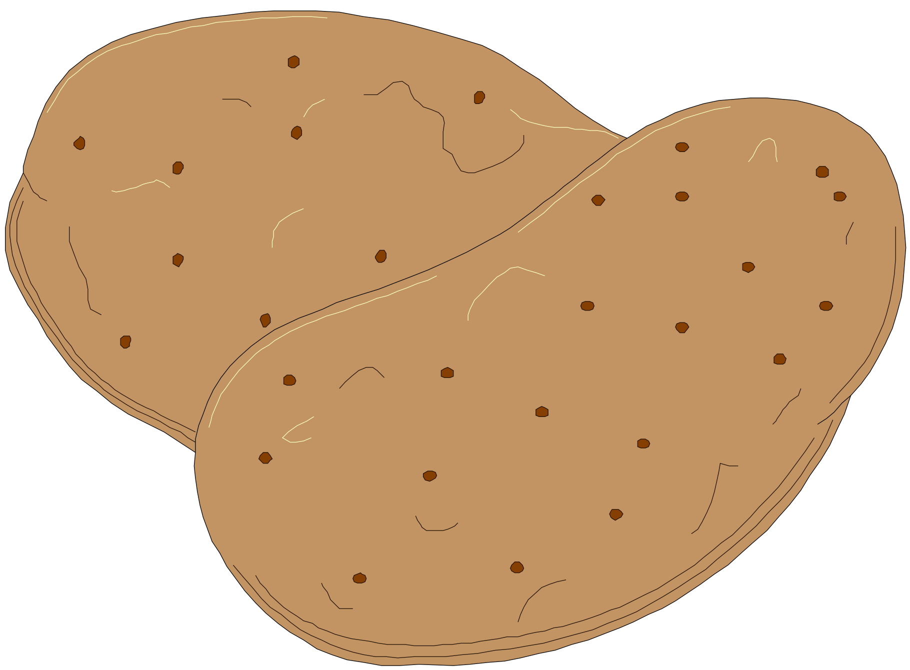
Investigation to Determine the Water Potential of Potato Tuber Cells .



AS Biology Coursework

Aim:
Investigate and determine the water potential of potato tuber cells.

Water potential is a measure of the tendency of water molecules to pa ss from one place to another. The principle in this experiment is to discover a solution of known water potential, in which the tissue being examined neither gains nor loses water. Samples of the tissue are allowed to come to equilibrium in a range of solutions of different concentrations and the solution which induces neither an increase nor a decrease in mass or volume of the tissue has the same water potential as the tissue. The method is described below.

Materials

- Fresh potato tuber
- Distilled water
- 1 mol dm^{-3} sucrose
- 6 test tubes
- Test tube rack
- Labels or wax pencil
- 2 * 10 cm^3 or 25 cm^3 graduated pipettes
- Tile
- Scalpel or knife
- 2 * 100 cm^3 beaker

Method

1. I was provided with a solution of 1 mol dm^{-3} sucrose. I made up 40 cm^3 of each of the following dilutions: 0.2, 0.4, 0.6, 0.8, 1.0 mol dm^{-3} sucrose.

2. I placed the dilutions in a series of boiling tubes. I also filled one tube with 40 cm^3 1mol dm^{-3} sucrose.

3. I sliced 12 strips of potato of dimensions as long as possible by approximately 0.5 cm by 0.5 cm.
4. I measured their length accurately as possible to the nearest mm and recorded it. I put two strips in each of the solutions.
5. I left the strips for at least 50 minutes.
6. I removed the strips from the solutions and re-measured them.
7. I calculated their mean change in length.

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Below is a table of results showing the lengths of potato strips left in distilled water or different concentrations of sucrose solution for about 50 minutes.

Morality of sucrose solution	*Length of potato strips at start (mm)*		*Length of potato strips after 50 mins (mm)*		*Average length of potato strips (mm)*		*Difference between potato strips (mm)*
	1	2	1	2	1	2	
0.0	48	50	50	53	49	51.5	2.5
0.2	51	52	52	53	51.5	52.5	1.0
0.4	49	50	49	50	49.5	50	0.5
0.6	48	50	46	49	49	49.5	0.5
0.8	51	51	48	49	51	51	0.0
1.0	48	49	47	46	48.5	47.5	-1.0

Analysing & Conclusion

The set of results and the graph shows that as the concentration of sucrose increases in the experiment, the length of potato strips decrease.

The graph shows at pure water (0.0) the change in length was the highest change. As the sucrose solution increases the graph gradually slopes downwards. At 0.4 sucrose solution the graph shows a 0.5 mm change in length. This length remains unchanged throughout until 0.6 sucrose solution. This can be an experimental error. At 0.8 sucrose solution the change in length is 0.0 mm. This is were the curve cuts the axis. This means that the external water potential and the internal water potential and the internal water potential was equal as there was no water molecule movement. At the final sucrose solution (1.0) the change in length was -1 mm. The size of the potato strips decreased. All these changes were due to the process called osmosis.

Osmosis is the passage of water molecules from a region of higher water potential to a region of lower water potential through a partially permeable membrane. It is best regarded as a form of diffusion in which only water molecules move. The tendency of water molecules to move from one place to another is measured as the water potential, represented by the symbol Ψ. Water always moves from a region of higher water potential to a region of lower water potential. Solute molecules reduce water potential. The extent by which they lower water potential is known a solute potential given the symbol Ψs.

Water Potential (Ψ)

Water molecules posses' kinetic energy, which means that in liquid or gaseous form they move rapidly and randomly from one location to another. The greater the concentration of water molecules in a system, the greater the total kinetic energy of water molecules in that system and the higher its so-called water potential. If two systems containing water are in contact the random movement of water molecules will result in the net movement of water molecules from the system with the higher water potential to the system with the lower water potential until the concentration of water molecules in both systems is equal.

Solute Potential (Ψs)

The effect of dissolving solute molecules in pure water is to reduce the concentration of water molecules and hence to lower the water potential. All solutions therefore have lower water potential than pure water. The amount of this lowering is known as the solute potential. In other words, solute potential is a measure of the change in water potential of a system due to the presence of solute molecules. Solute potential is always negative. For a solution:

$$\Psi = \Psi s$$

This means if the solute potential can be found than the water potential is automatically found or vice versa. In this investigation we would like to work out the water potential inside to potato strips. If the solute potential is known then the water potential is known. From the graph it can be seen that there is no change in length and 0.8 sucrose solution. This means that at that point the internal and external solution of the potato strips were equal. Using the morality table the solute potentia l of the potato strips at 0.8 sucrose solution can be worked out.
At 0.8 sucrose solution the table shows that the solute potential is -2580. From this we can work out water potential of the potato strips. $\Psi = \Psi s$, therefore $\Psi = 2580$ =>

2580 = Water potential inside potato.

Evaluation

I think that the experiment went very well. There were no odd results and they produced a good graph. Even though the results came out fairly good but still there was room for improvement. During the experiment, some minor errors may have been encountered. These errors are as follows: -

Two different potatoes were used for the experiment. The results could have been affected by this because the internal of the two potatoes may have been different.
When I got rid of the solutions from the tube in order to carry the potatoes strips, I might have either taken some water out of the strips or I might of left some excess water in the potato. This part of the experiment is difficult to come up with an accurate and fair method, as other ways would also lead to some slight inaccuracy.