Investigating the Water Potential of Celery Cells.

Aim

I will be investigating the water potential of celery and to find out which solution will be isotonic with the celery cells, in other words equilibrium between the two no water will leave the cell, or enter. I will do this by following this method.

Method

1. Cut a 5 cm length of celery stem
2. Cut through the grooves to divide the stem into thin strips
3. Dry the cell sap from the strips using a paper towel
4. Record and note the mass of each strip
5. Collect 6 test tubes, and put 10 cm^3 of solutions 0.0, 0.1, 0.2, 0.3, 0.5, 0.7, 0.8. In separate test tubes
6. Cut each celery piece into 5 cm cubes and place into test tubes
7. Leave for 30 mins at room temperature
8. And collect the strips out of the test tubes, dry them and record the mass of each strip

Prediction

I predict that as the concentration of sucrose increases, The cell will firstly become turgid, as since the concentration is low the water potential outside the cell will be higher than inside to water will diffuse in. Then as the concentration gets higher the water potential outside will become lower than inside the cell so water will diffuse out and the cell will become plasmolysed.

I also predict that solution concentration 0.3 will be isotonic because of the pressure potential. As the water moves into the cell it pushes up against the cell wall this is called the pressure potential and it increases the water potential until an equilibrium is reached, and because the cell is so inelastic it takes very little water to achieve this. That's why I believe in-between 0.3 and 0.4 will be isotonic as it is very close to pure water.

Background Information

Osmosis – The net movement of water molecules from a region of high water potential to a low water potential, through a selectively permeable membrane until equilibrium is reached.

Water Potential (Ψ) – The tendency of a solution to lose water; water moves form a solution with high water potential to one with a low water potential. Water

potential is decreased by the addition of solute, and is increased by the application of pressure.

Osmosis is a special type of diffusion that only deals with the movement of water molecules. A solution it is made up of a solute and a solvent, so for example in a sugar solution the sugar is the solute that is dissolved in the solvent, which is water. How much of the solute in the solvent determines the water potential of the solution. If there is a concentrated amount if the solute in the solvent the solution will have low water potential, and if there is a dilute amount of solute in the solvent the solution the solution will have a high water potential. So in a cell if the surrounding fluid water potential is more positive than that inside the cell the water will move from the high (positive) water potential, to the lower (more negative) water potential in the cell until and vice versa until an equilibrium is reached.

This process is slightly different in plant cells, in animal cells osmosis will occur and keep occurring while there is an concentration gradient, and this could lend to the cell bursting. Plants cells are different they have a cell wall so when substances pass into the cell the volume of the cell increases just like the animal cell, but the protoplast starts to push against the cell wall and increases the pressure rapidly. This is called the pressure potential and this increases the water potential inside the cell until it is the same as the outside so equilibrium is reached.

Saftey Issues

- Caution must always be used when using the scalpel as it is sharp
- Lab coats must always be worn when dealing with any substance, in this case the sucrose solution will be sticky if it gets on clothes.

Variables

Constant Variables

- The volume of sucrose solution will always be 10cm³
- The length of the celery pieces will always be 5cm
- To reduce percentage error the same scale will always be used foe every measurement
- The temperature will be controlled at 24.5°c
- The pressure will also be controlled

Controlled variables

Concentration of solution: -

- 0.0
- 0.1
- 0.3

- 0.5
- 0.7
- 0.8

Uncontrolled Variables

- % Mass change in celery mass
- Surface area of celery pieces

Results

Concentration of Sucroce solution ($mol.dm^{-3}$)	Original Mass (g)	Final Mass (g)	Change (g)	% Change (%)
0.0	0.73	0.82	0.09	12.33
0.1	1.02	1.13	0.11	10.78
0.3	0.53	0.57	0.04	7.55
0.5	0.93	0.79	-0.14	-15.05
0.7	1.08	0.85	-0.23	-21.31
0.8	0.85	0.65	-0.20	-23.53

Analysis

From the table and graph the results show a general decline, which shows negative correlation. So as the concentration of the solution increased the more water passed out of the celery cells. From the graph three other trends can be established from 0.0 – 0.2 and 0.6 – 0.8 the % change in mass is big because the solution water potential difference outside the cell is so different from that inside the cell so water moved across the pressure gradient until equilibrium is reached. In between 0.2 – 0.5 the % change is less as the substances are nearly isotonic this is when there is already an equilibrium so no water needs to be exchanged and from the graph the concentration in which the solution is isotonic is 0.36. Which supports my prediction.

Evaluation

The experiment went well and my hypothesis was supported and there were no anomalous results. This experiment could be improved firstly when the celery pieces were cut they were cut to the same mass but surface area was not taken into account and if a particular celery piece had a larger surface area then another more osmosis would occur to counterbalance this a template should be used to cut the celery pieces. Also the measuring equipment had percentage errors more accurate measuring equipment would be desirable. The celery pieces could of clumped together inside the boiling tube hence lowering the overall surface area and would effect the results. The pressure inside the room

was not controlled if there was an increase in pressure it could effect the water potential of the solutions.