Investigating the effect of osmosis on plant tissues

Transcript

Osmosis is a specialised form of diffusion where there is a net movement of water molecules from high water concentration to low water concentration through a partially permeable barrier that other molecules cannot pass through.

Plant cells have a partially permeable membrane that lets water move into and out of the cell by osmosis.

When there is a higher concentration of water outside of the cell than there is inside the cell, water will move into the cell.

When the concentration of water inside the cell is higher than the concentration of water outside of the cell, water will move out of the cell.

This experiment will investigate the effect of osmosis on plant tissues using potatoes as the plant source.

Potato samples will be submerged in different concentrations of sucrose solution for 15 minutes. The mass of the potato will be taken before and after. The rubber stopper in each tube prevents any water evaporating and changing the concentration of the solutions.

A cork borer is used to cut three potato cylinders on a solid surface such as a white tile. Another borer or a pencil is used to remove the potato.

The skin is removed from each end. Care is taken when using a scalpel.

Each potato cylinder is cut in half. The resulting 6 cylinders are roughly the same length.

Five different concentrations of sucrose solutions are added to labelled boiling tubes. The 0% sucrose solution contains only distilled water. This is the control.

The potato cylinders are dried to remove any surface water that could affect the results.

The starting mass of each potato cylinder is recorded before being added to a boiling tube.

It is important to record the potato mass against the correct sucrose solution.

The potato should be completely covered by the solution.

The timer is started and the samples are left for 15 minutes.

After this time the potato cylinders are carefully removed from the boiling tubes. They are placed on a paper towel in the same order that they were removed, so that they are not mixed up.

Excess liquid on the surface of the potatoes is removed.

The mass of each potato cylinder is recorded, and the change in mass is calculated.

Calculating the change in mass for each potato sample is not enough for quantitative comparisons because the starting masses are not the same.

The *percentage change* in mass needs to be calculated. This is done by dividing the change in mass for each potato cylinder by its starting mass, and multiplying by 100.

After the percentage change has been calculated, record if the change was an increase or a decrease.

The results are plotted on a graph.

The concentration of the sucrose is plotted on the *x*-axis as it is the independent variable and the percentage change in mass is plotted on the y-axis as it is the dependent variable.

A curve of best fit is drawn through the plotted points.

The scale on the *y*-axis, indicates if the percentage change in mass is an increase or a decrease. The scale on the *x*-axis shows the change in sucrose concentration.

Between 0% sucrose solution and about 10% sucrose solution, the change in mass was an increase.

At concentrations over 10%, the change in mass was a decrease.

Why might this be?

The 0% sucrose solution is just water without any solutes, so it has a very high water concentration. Therefore, it is reasonable to conclude that the potato cells contained a lower water concentration and water moved into the cells by osmosis, causing the potato's mass to increase.

The 100% sucrose solution is very concentrated, so it has a very low water concentration. Therefore, it is reasonable to conclude that the potato cells contained a higher water concentration than the solution, and water moved out of the cells into the solution by osmosis, causing a decrease in their mass.

At a concentration of around 10% sucrose, the curve crosses the *x*-axis. Here, the percentage change in mass of the potato is zero. This suggests that there was not a net movement of water into, or out of, the potato cells.

This suggests that at 10% sucrose, the concentration of water inside the potato cells is the same as the concentration of water in the sucrose solution.

The curve shows that as the concentration of the sucrose solution increases, the mass of the potato sample decreases. But the relationship is not linear.

Between the concentrations of 0% and 40% sucrose solution, the curve is steeper than it is between 40% and 100% sucrose solution.

This suggests that the percentage change in mass is not constant; the change in mass is greater at lower concentrations of sucrose than it is at higher concentrations of sucrose.

Why might this be?

There is a limit to how much water the potato cells can lose, so after a point, the change in mass will slow down even if the concentration of sucrose increases.

This investigation shows that plants can lose or gain mass due to water movement through osmosis. This has many implications for plants, including helping to prevent their leaves and flowers from wilting.