Ccea as biology coursework: an investigation to find the water potential of potat...

An investigation to find the water potential of potato and carrot tubers in a sucrose solution, of concentration 0. 00 – 0. 50Mol, over a 24 hour period Interpretation Written Communication C1 From our graph it can be seen that the concentration of sucrose solution is 0. 18 M at 0% change in mass for the potato and 0. 355 M at 0% change in mass for the carrot. I will use these values to find the solute potential by using the calibration graph. I will work out the water potential by using the equation, ? =? s +? p (Water Potential = Solute Potential + Pressure Potential). The ? s of the potato at 0% change in mass is -500 kPa and the ? of the carrot at 0% change in mass is -1000 kPa. Through the use of our equation, the water potential of the potato and carrot are -500 kPa and -1000 kPa (respectfully) as in this case the solute potential equals the water potential as there is no pressure potential as the solution is open and it isn't under a membrane so it is not under pressure. The Water Potential (?) of the solution is equal to the ? of the tuber as there is no pressure potential. C2 and C3 As the concentration of the sucrose solution increases, the average percentage change in mass decreases in the potato tubers and this is the same as in the carrot tubers.

At low concentrations of sucrose solutions (0. 1 M) the mass of the carrot and potato tubers increases due to water moving into the protoplast of the cell from the sucrose solution by osmosis and at high concentrations of sucrose solutions (0. 5 M) the mass of the carrot and potato tubers decreases due to water moving out of the protoplast of the cell to the sucrose solution by osmosis. At certain concentrations (0. 18 M of the potato and 0. 355 M for the carrot) the potato and carrot tubers don't change in mass due to the

water potential inside the cells equalling the water potential of the sucrose solution.

My graph displays a distinct negative correlation; the higher the concentration of sucrose solution, the larger the difference between the mass over the 24 hour period becomes, and the smaller the mass gets. Osmosis is the movement of water from a high water potential to a low water potential across a semi-permeable membrane. C4 and C5 Osmosis is the net movement of water particles from areas of high water potential to areas of lower water potential across a semi-permeable membrane, such as the cell membrane.

This can also be described as moving down a concentration gradient. The water potential of a substance measures the amount of free energy that is available in an aqueous solution to cause the migration of water molecules during osmosis. The symbol for water potential is ? and is measured in kPa (kilo-pascals). The water potential of pure water is zero, as all the particles are free; this means that all particles contain kinetic energy and are under attractive forces, so they in constant random movement. In relation to my results, at concentration 0. 8M for the potato and 0. 355M for the carrot, there is an osmotic balance between the potato and carrot cells and sucrose solution – the water potentials are equal. This is also known as an isotonic solution – where equilibrium is reached between the rates of osmosis in and out of a solution. Above this value, the solution becomes hypertonic (having a higher solute concentration than the potato and carrot), while below this

value, the sucrose solution becomes hypotonic (having a lower solute concentration than the potato and carrot).

A hypertonic solution has a higher concentration of solutes compared to another solution, while a hypotonic solution has a lower concentration of solutes compared to another solution. An isotonic solution has an identical concentration of solutes as another solution. These can also be described as having a lower, identical, and higher osmotic pressure, respectfully, than another solution. I noticed that the hypertonic potato and carrot had become soft and lost all of its structural integrity, and was generally flaccid.

This became more noticeable as the concentration of the sucrose solution increased and the percentage change in mass gets more negative. Evaluation D1 I consider my results to be appropriate in meeting the aims of this investigation as we measured the change in mass of the potato as opposed to measuring the change in length as it will give an indication of the amount of water entering the potato and carrot due to osmosis. All measurements were made to two decimal places meaning the level of accuracy is very high and that the scales used could detect even the slightest changes in mass. D2

In order to try to obtain accurate results a number of procedures had to be carried out; • Firstly, we covered the top of each test tube with cling film to reduce the amount of water evaporating from the sucrose solution. If water were to evaporate from the solution, it would mean that the solution would become more concentrated and this seriously affect the amount of water entering the potato and carrot as the water potential in the external solution

would be drastically lower than that of the potato and carrot cells. • Secondly, we used the same volume of sucrose solution in each test tube.

If the quantities of each solution were not equal, instead of getting the desired concentration of sucrose solution, a slightly different concentrated solution would be produced. This will affect the potato and carrot by exposing it to a different concentration of sucrose solution, therefore giving us a different result to the one expected. This happens as osmosis occurs because of the kinetic energy found in the water molecules. The kinetic energy causes the particles to vibrate and move randomly – moving around the area in which they are held. The random movement causes the particles to distribute randomly around the area.

The higher concentrated solution has more particles that can move across the membrane compared to the lower, producing a net movement down the concentration gradient. • Thirdly, we tried to maintain the temperature by keeping the test tubes in a regulated room. If the temperature were to increase it would cause the kinetic energy of the sucrose solution increase and if the temperature were to decrease it would cause the kinetic energy of the sucrose solution to decrease. • I also tried to ensure that each tuber was dried in the same way, but this proved to be very difficult.

It was important to only remove the solution from the surface because we did not want to remove any water from the cells which would affect the mass of the tubers. • Lastly, each tuber was sourced from the same potato or carrot as every potato and carrot have a different composition of starch and sucrose which would alter the solute potential of the potato and carrot and

this has an effect on the amount of water that enters or leaves the tubers by osmosis. D3 Although the experiment was as fair as it could have been, there were some factors that were beyond our control.

Firstly, the tubers that we used may not have been from the same specimen, although the specimen may have been from the same bag they could be biologically different. Secondly, there could have been some skin left on the tubers which could have affected the rate at which the water entered the tubers due to osmosis. Thirdly, when we were weighing the tubers we had to handle them which could have extracted some water from the tubers, this would alter the true weight of the tubers after 24 hours and therefore alter the results of the experiment.

D4 and D5 My experiment is reliable as it was repeated six times in the form of the pooled class result. However, there were a few anomalies among the group results e. g. some groups have higher or lower results than the others; this would cause the average class result to be lower or higher depending on the value of the anomaly. This could be as simple as the use of different potatoes and carrots being used for each group or any of the reasons mentioned in D3.