In this investigation I am going to find out how a chip is affected by the concentration of the salt water, the length or width of the chip or the length of time the chip is in the solution for.

Osmosis

Osmosis is the movement of water through a selectively permeable membrane separating solutions of different concentrations. Water passes by diffusion from a weak solution (high water concentration) to a strong solution (low water concentration) until the two concentrations are equal. The selectively pemeable membrane allows diffusion of water but not of the solute. The level of liquid in the tube of sugar solution will eventually rise until the flow of water from the tube of sugar solution, under the influence of hydrostatic pressure, equals the flow of water into the tube. The hydrostatic pressure establishing this equality of flow is called osmotic pressure. A variety of physical and chemical principles are involved in the phenomenon of osmosis in animals and plants.

Osmoregulation

Excessive flow of water into a cell by osmosis can burst the cell. Cells protect against this using processes of osmoregulation. If external pressure is applied to the stronger solution, osmosis is arrested. By this mechanism plant cells can osmoregulate, since the cell wall of a fully turgid cell exerts pressure on the solution within the cell. Animal cells such as the red blood cell cannot osmoregulate in this way since they have no cell wall. Instead, the kidneys maintain the correct concentration of plasma.

Diffusion

Diffusion is a spontaneous and random movement of particles in a fluid from a region in which they are at a high concentration to region of lower concentration, until a uniform concentration is achieved throughout. The difference between two such regions is called the concentration gradient.

In biological systems, diffusion plays an essential role in the transport, over short distances, of molecules such as nutrients, respiratory gasses, and neurotransmitter. It provides the means by which small molecules pass into and out of individual cells and microorganisms, such as amoebae, that possess no circulatory system. Diffusion over a semi permeable membrane is called Osmosis.

<u>Flaccidity</u>

The loss of rigidity (turgor) in plant cells, caused by loss of water from the central vacuole so that the cytoplasm no longer pushes against the cellulose cell wall. If this condition occurs throughout the plant then wilting is seen.

Flaccidity can be induced in the laboratory by immersing the plant cell in a strong saline solution. Water leaves the cell by osmosis causing the vacuole to shrink. In extreme cases the actual cytoplasm pulls away from the cell wall, a phenomenon known as plasmolysis.

<u>Plasmolysis</u>

Plasmolysis is the separation of the plant cell cytoplasm from the cell wall as a result of water loss. As moisture leaves the vacuole the total volume of the cytoplasm decreases while the cell itself, being flaccid hardly changes. Plasmolysis is induced in the laboratory by immersing the plant cell in a strongly saline or sugary solution, so that water is lost by Osmosis.

References: Class notes – Miss Berry
            Internet – www.helicon.com
                - www.howstuffworks.com
            CD ROM – Encarta
            Class book - GCSE Biology by David Baylis

<u>Preliminary Results</u>

Dilutions- How to create different concentrations of the salt solution

1) Measure out 200 ml of distilled water and then add 800 ml of t able salt, which will create 80 % salt solution.
2) Measure out 200 ml of distilled water and now only add 120 ml of salt, this will create 60 % salt solution.
3) To create 40 % salt solution measure out 200 ml of distilled water then add 80 ml of table salt.
4) Then finally to create 20% salt solution measure out 200 ml of distilled water and then add 40 ml of table salt.

<u>Method</u>

1) Set up and create concentrations.
2) Take 5 core samples from a potato then measure them individually.
3) Place one core sample into each of the salt concentrations and leave it there.

4) Every 10 minutes take out each core sample and dry in on a paper towel then weigh it and record the mass.

In this preliminary experiment I used various concentrations of salt to create a salt solution. I simply recorded the mass of chips of the same size at various times in the various concentrations; to see how much mass each chip loses due to plasmolysis. The table below shows the results of this experiment.

Concentration	Mass before (g)	Mass after (g)		Mass difference (g)
		10 mins	20 mins	
0%	5.6	5.8	5.9	0.3
20%	5.5	5.3	5	-0.5
40%	5.3	5	4.9	-0.4
60%	5.6	5.3	5.1	-0.5
80%	5.5	5.1	5	-0.5

Even though this table does show the results I was expecting, I believe that the salt concentration is too high, because the salt at a 40 % salt concentrate the solution was saturated so the results above are not accurate. So in light of this I have decided to decrease the concentration of salt solution.

Variables

There are many factors that would affect the amount of shrinkage in the size of a chip in a salt solution, such as, the concentration of the salt solution, the length or width of the chip and the time the chip is in the solution. The length of time the chip is in the solution could lead to Osmoregulation, as the longer the chip is in the salt solution the susceptible the chip is to an excessive flow of water into a cell by osmosis which can burst the cell and lead to shrinkage in the size of the chip. Plasmolysis can also occur in all of the factors above, as the salt absorbs the moisture so as moisture leaves the vacuole the total volume of the cytoplasm decreases while the cell itself, being flaccid hardly changes, which then leads to plasmolysis as a result of the water loss, which would also decrease the size of the chip.

Measurement

In this investigation I am going to measure the mass of the chips in grams, and the time in the water in minutes. I am also going to measure the concentration in percentages.

Prediction

I predict that the lower the salt concentration is in the solution the less the chip will decrease in size. I think this because if the chips are in a less saline solution the less susceptible the chip is to shrinkage, due to plasmolysis. Plasmolysis is the separation of the plant cell cytoplasm from the cell wall as a result of water loss. As moisture leaves the vacuole the total volume of the cytoplasm decreases while the cell itself, being flaccid hardly changes. Immersing the plant cell in a strongly saline or sugary solution induces plasmolysis, so that water is lost by Osmosis. Salt also causes water loss through osmosis that would also lead to flaccidity, which will then therefore lead to plasmolysis. As a result of which leads to the shrinkage in size of the chips. Flaccidity is the loss of rigidity (turgor) in plant cells, caused by loss of water from the central vacuole so that the cytoplasm no longer pushes against the cellulose cell wall. If this condition occurs throughout the plant then wilting is seen.

Immersing the plant cell in a strong saline solution can induce flaccidity. Water leaves the cell by osmosis causing the vacuole to shrink. This causes the actual cytoplasm to pull away from the cell wall, an occurrence known as plasmolysis.

Method

Equipment:
- 3 large potatoes
- 11 mm Borer
- Salt
- Cold tap water
- Balance
- Stopwatch,
- Measuring cylinder, (100 ml)
- Paper towels
- Small beaker (100 ml)
- 5 medium sized glass beakers (200 ml)

Dilutions- How to create different concentrations of the salt solution

5) Measure out 100 ml of water and then add none of the table salt, which will create 0% salt solution.
6) Measure out 95 ml of water and now add 5 ml of salt, this will create 5 % salt solution.
7) To create 10 % salt solution measure out 90 ml of water then add 10 ml of table salt.
8) To create 15% salt solution measure out 85 ml of water and then add 15 ml of table salt.
9) Then finally to create 20 % salt solution measure out 80 ml of water and then add 20 ml of table salt.

Method

Once you have set up the apparatus as shown before, and created the concentrations. Take five core samples using the 11 ml borer. Once you have completed that, remember to cut each sample to 3 cm, so that each of the samples are the same size to make it a fair test. Weigh the mass of each core sample and designate the core sample to a concentration and record the mass before. After you have done that place each core sample into its designated concentration at the same time and start the stopwatch. Then stir the solution with the sample in it 5 times using a spatula, and then leave it for until the stopwatch reaches ten minutes. Once it reaches ten minutes stop the stopwatch and takes the entire sample out of the solution and places them outside the designated beaker to prevent concentration. DO NOT TOUCH THE CONTROL SAMPLE WITH ANY OF THE EQUIPMENT USED FOR THE SAMPLE IN THE SALINE SOLUTION as this prevents contamination of the control sample. Dry each sample on the paper towels, then weigh them separately and record the mass for each. Repeat this cycle for 30 minutes. Once you have done this repeat the whole process twice more, with new potato samples, so you can calculate an average.

The precautions that I have taken in this investigation to prevent any contaminations from other samples and the repetitions of the experiment to calculate an average, is to prevent any major inaccuracies occurring in the results. I have also made this investigation a fair test by only altering the concentration of the saline solution.

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Results

Concentration	Mass before	Average	10 min	Average	20 min	Average	30 min	Average	Mass difference	Average
	4.9		5		5		4.9		0	
	5.1		5.3		5.3		5.3		0.2	
0%	5.3	5.1	5.4	5.2	5.4	5.2	5.4	5.2	0.1	0.1
	3.5		3.4		3.3		3.2		-0.3	
	5.4		5.4		5.2		5		-0.4	
5%	4.2	4.4	3.9	4.2	3.8	4.1	3.6	3.9	-0.6	-0.4
	4.8		4.6		4.4		4.3		-0.5	
	5.1		5.1		4.8		4.6		-0.5	
10%	5.1	5	4.9	4.9	4.6	4.6	4.5	4.5	-0.6	-0.5
	4		3.8		3.6		3.5		-0.5	
	5.6		5.5		5.3		5.1		-0.5	
15%	4.9	4.8	4.7	4.7	4.5	4.5	4.3	4.3	-0.6	-0.5
	5		4.7		4.6		4.4		-0.6	
	5.1		5		4.8		4.7		-0.4	
20%	5.7	5.3	5.3	5	5.2	4.9	5	4.7	-0.7	-0.6

The graph above shows the amount of mass lost by each sample in each concentration. As you can see the control sample has increased in weight this is because the potato has absorbed some of the solution through osmosis. While the other samples show symptoms of plasmolysis occurring. However, you can't distinguish if my hypothesis was correct from this graph, as it doesn't compare the average mass difference between each sample.

This graph shows that the greater the concentration of saline solution the more mass the chip will lose probably due to plasmolysis. This graph also shows that the control sample increased mass by an average of 0.1g; this was probably due to the process of osmosis.

Analysis

Analysing the first graph you can see that the mass of the samples in the concentrate saline solution has decreased the mass of the samples while the control sample has increased in mass due to the absorption of water due to osmotic process. The second graph shows the average difference in mass for each concentrate as you can see the graph corresponds with my prediction. Apart from the sample in 15% concentrate of saline solution which has the same difference as the sample in the 10% concentrate of saline solution. However, this result doesn't disprove my hypothesis as the graph clearly shows a strong negative correlation. In the first graph there were a couple of anomalous results, however, this could be due to a variety of aspects such as maybe one sample was in the saline solution a few second more than the rest. Though, the anomalous results are very subtle and slight. The only possible anomalous result on the second graph could be the point showing the mass difference at 15% concentrate of saline solution, but it is again subtle and doesn't affect the overall pattern of results.

Analysing all of the results you can clearly see that lower the salt concentration is in the solution the less the chip will decrease in size. This is probably because if the chips are in a less saline solution the less susceptible the chip is to shrinkage, due to plasmolysis. Plasmolysis is the separation of the plant cell cytoplasm from the cell wall as a result of water loss. As moisture leaves the vacuole the total volume of the cytoplasm decreases while the cell itself, being flaccid hardly changes. Immersing the plant cell in a strongly saline or sugary solution induces plasmolysis, so that water is lost by Osmosis. Salt also causes water loss through osmosis that would also lead to flaccidity, which will then therefore lead to plasmolysis. As a result of which leads to the shrinkage in size of the chips. Flaccidity is the loss of rigidity (turgor) in plant cells, caused by loss of water from the central vacuole so that the cytoplasm no longer pushes against the cellulose cell wall. If this condition occurs throughout the plant then wilting is seen.

Immersing the plant cell in a strong saline solution can induce flaccidity. Water leaves the cell by osmosis causing the vacuole to shrink. This causes the actual cytoplasm to pull away from the cell wall, an occurrence known as plasmolysis.

From the results that I have gathered through this investigation I have come to the conclusion that the greater the concentration of saline solution the greater the amount of shrinkage occurs. Using my graph showing the average difference of mass for each concentration, I have estimated a percentage of saline solution that won't increase nor decrease the mass of a chip, and it is 1 % saline solution, which would consist of 99 ml of tap water to 1 ml of table salt. Of course, it is just an estimate based on a graph. I can't really make a reliable conclusion on the results I have collected concerning the estimate I have just made as it is just an estimate it does not at the moment have any hard evidence backing this estimate.

Evaluation

I believe that whilst carrying out this investigation, I went to every length to ensure that this investigation the fairest test I could possibly have completed. I also think that I took enough accurate readings to create a satisfactory hypothesis, and analysis. Of course like everything the results could have been in a lot more detail, such by measuring mass to 2 decimal places, but unfortunately the balances couldn't accommodate that. I could have also made it fairer by testing more concentrates of saline solution, including 1%, which would have acted as evidence to my estimation. I still believe that my results are very accurate, since I repeated each measurement three times and then took an average, to prevent any major anomalous results occurring.

Looking at my graph and its line of best fit, you can see that there are a couple of points that don't really fit the pattern. However they all follow the trend of the other points, and it doesn't really affect the overall pattern or correlation. I believe that this method was reasonably secure, and that if performed properly there would be no major errors. However, the method was very simple and primitive, yet affective. As this is what would happen in reality. For instance, if you are making chips and you put the potatoes in a saline solution and they decrease in mass it might not be as scientific but the results are just as valid, because it can be conveyed to a human problem easier. The method would have been improved and more secure if I could have controlled such factors as, the length of time the sample is in the concentrate. I had great difficulty in this investigation is removing all of the samples from the different saline solution at the same time without contaminating the control sample.

I believe that I have enough reliable results to draw a valid scientific conclusion. However, I don't have enough results to come to a conclusion concerning my prediction involving a concentrate of saline solution that a potato sample won't decrease in mass.

I could have developed this investigation by testing a greater variety of concentrates, including 1% saline concentration to prove or disprove my hypothesis concerning a concentrate of saline solution that a potato sample won't decrease in mass.

This investigation is useful for chip shop that prepares the chip hours before frying them. As it allows them to do so without the mass and size of the chips decreasing.

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