The Effect Of Concentration Of Blackcurrant Solution On The Change Of Mass And Rate Of Osmosis In Potato Cells

Introduction-

Cells are the building blocks of every single living thing. Cells have many purposes, they provide structure for the body, yield in nutrients from food and convert the nutrients into energy and finally they are used to perform specific functions. The cell membrane is one of the most important parts of a cell. It is the part of the cell that controls movement, simply what goes in and out of the cell. The cell membrane separates the internal environment of the cell from its surroundings. A cell membrane is made out of three layers two hydrophilic layers and 1 hydrophobic layer. The two hydrophilic layers are the layers that allow water to pass through but the one hydrophobic layer in the middle is afraid of water which does not allow any water to pass through. Osmosis is the diffusion of water osmosis goes from a high concentration to a low concentration. Osmosis means water travels from the side with a high concentration to a side with the low concentration to equalize the concentration on both sides. Water molecules travel through the plasma membrane by diffusing through the lipid bilayer. The rate of osmosis is greatly affected by the concentration. The lower the concentration the faster the rate of osmosis will occur in that solvent.

Aim-

To observe the effect of concentration of blackcurrant solution and how it effects the change of mass and also rate of osmosis in potato cells

Hypothesis-

If the potato cells are placed in high concentration blackcurrant solutions (e.g. 100% or 80% - hypertonic) there will be net movement of water out of the potato cells which will lead to a decrease in mass.

How will the results support the hypothesis?

The hypothesis will be supported by the results by observing the high concentration blackcurrant solutions will decrease in mass.

Scientific reasoning

The reason it has been hypothesized that the potato cells in hypertonic solutions will increase in mass is because of the net movement. Hypertonic solutions in this investigation are the solutions with a higher concentration of blackcurrant solution compared to water. With hypertonic solutions it is more likely to have net movement out of the cell which means the liquid inside the potato cells will transfer to the external environment.

Variables

- Independent- Concentration of blackcurrant solution- The concentration of blackcurrant solution begins at 0% (water) and then goes to the highest concentration of 100%.
- Dependent- Rate of osmosis- The date of osmosis is the dependent because the main purpose of this experiment is to discover which concentration of blackcurrant creates the highest rate of osmosis in potato cells.
- Controlled- Amount of liquid, Potato cutter, time limit, timer
- Amount of liquid- The amount of liquid should theoretically be 20ml for all 7 of the blackcurrant concentrations.
- Potato cutter- For all 7 tests the same potato cutter is used for all of the potato strips.
- Time limit- The time limit is the exact same for all 7 tests being 20 minutes.
- Timer- The timer is left the exact same for the whole of the investigation.

Apparatus

- 7x blackcurrant solutions
- 7x large test tubes
- 1x ruler
- 1x knife
- 1x whole potato
- 1x stopwatch
- 1x potato borer
- 1x roll of paper towel
- 1x tweezer
- 1x electronic balance
- 1x pipe cleaner
- 1x test tube rack
- 1x measuring cylinders

Method

1. A total of 7 test tubes were collected and using a measuring cup 20ml of one blackcurrant solution was poured into the test tube, making sure that each test tube had a different concentration in it.
2. A potato borer was then used to cut out 7 even potato strips in the shape of a cylinder that were then all cut to 3.5cm in length.
3. After the potato strips were cut out using a paper towel, they were pat dry and then measured on the electronic balance.
4. Then a potato strip was placed in each solution and a timer was set for exactly 20 minutes.
5. Once 20 minutes had been by, the black currant solution was them emptied out of each test tube and the potato was collected from each test tube using a tweezer.
6. The potatoes were then all pat dry and weighed using the electrical balance, results were then recorded.

Safety

There are many dangerous tools and liquids being used throughout this experiment. Using the knife carefully is very important and having full focus while using it is very important. Making sure that the saline solution does not get in contact with any parts of the face is also extremely important and is another caution to be aware of.

Results

The concentration of Black-current solution (%) / Initial Mass of Potato g

(B) Final Mass of potato g

(A) Change in Mass of Potato g (A-B) % Change in Mass of Potato

A-B/B x 100 = C Rate of Osmosis

C/time in minutes

- 0 2.01 2.06 0.05 2.49 0.1245
- 5 2.00 2.01 0.01 0.5 0.025
- 20 1.95 2.01 0.06 3.078 0.1539
- 40 1.90 1.95 0.05 2.63 0.1315
- 60 2.00 1.98 -0.02 -1.01 -0.05
- 80 2.00 1.95 -0.05 -2.564 -0.1282
- 100 2.00 1.96 -0.04 -2.04 -0.102
- Black-current Concentration (%) / Group 1 (g) / Group 2 (g) / Group 3 (g) / Group 4 (g) /Group 5 (g) / Group 6 (g)
- 0 0.17 0.12 0.16 0.90 0.15 0.032
- 5 0.18 0.03 0.16 -0.50 0.03 0.74
- 20 0.17 0.15 0 -0.10 -0.03 0.14
- 40 0.32 0.13 -0.03 -0.049 -0.03 0.04
- 60 0.02 -0.05 -0.27 -0.098 -0.06 -0.07
- 80 -0.50 -0.13 0 -0.47 -0.12 -0.15
- 100 -0.14 -0.10 -0.21 -0.14 -0.16 -0.24

- Black-current Concentration (%) / Average (g) / Minimum Value (g) / Maximum Value (g)
- 0 0.26 0.032 0.9
- 5 0.11 -0.5 0.74
- 20 0.06 -0.1 0.17
- 40 0.06 -0.049 0.32
- 60 -0.09 -0.27 0.02
- 80 -0.24 -0.5 0
- 100 -0.17 -0.24 -0.1

Random error

There were only a small number of random errors that occurred throughout the investigation. The first was that the test tube containing 60% blackcurrant solution was not filled to exactly 20ml as the other 6 solutions were. It was filled to a lower amount which may have affected the

final change in mass and also the rate of osmosis.

The potatoes are all slightly different in weight which does mean the results will not be 100% accurate. This does decrease the reliability of this investigation as the potatoes are not all the same mass and the results are not being compared from 7 potato strips that are the exact same mass.

Systematic errors

Not taking the potatoes out at the same time was a systematic error because this means the potatoes have been in the solution for different amounts of times. The way that can change this is by having more then one person taking out the potatoes from the solutions.

The other systematic error recognized was that the size of the potato strips in the group were all cut to 3.5cm rather then 3cm. This could have changed the final average for all groups because the numbers may have been far higher or far lower compared to all groups. The graph could be changed because of this.

Improvements

The first improvement recognized was that while the saline solutions were being putting in the test tubes the measuring cylinder was not cleaned with water after each solution was used. This could have changed the results as each solution would not have been the exact concentration that it was supposed to be.

Another improvement that could be made is to have more then one potato strip in each of the test tubes. The reason that this would improve this experiment is because it will give more results for each different concentration blackcurrant solution. This will allow more results to be compared and allow the results to be even more accurate then they already. This is because more potatoes are being compared and increase the reliability.

Discussion

From the graphs above it shows that the hypotonic solutions (0%, 5%) increase the mass of the potato strips while the hypertonic solutions (100%, 80%) decrease the mass of the potato strips. The reason for this is because the hypotonic solutions are more likely to have net movement into the cell which means the mass is going to increase as more liquid will travel into the potato strips. While hypertonic solutions are more likely to have net movement out of the cell which means the mass of the potato cell will decrease. The group results show the same pattern an increase in mass as the concentration decreases.

Reliability of investigation

This investigation is fairly reliable within the circumstances that are given. They are precise because the length of the potatoes are all exactly 1cm x 3.5cm in length and the mass of the potato strips are all of the similar mass. This makes the results precise as the length and mass is fairly similar which makes the final results fair as each solution has a potato which is 1cm x

3.5cm.

Conclusion

To conclude, the hypothesis was supported by the results as the mass of the potato increases when placed in decreasing concentration of the blackcurrant solution. Majority of the results showed this, and the graph shows a trend as the hypothesis stated. The investigation was completed to a high standard with all steps followed exactly, no large problems were encountered.