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An experimental study on osmosis in potato cells

Aim

The aim of this experiment is to analyse how does osmosis differ depending on the type of solution in which the potato is immersed.

Introduction

Osmosis is a process by which molecules of a solvent tend to pass through a semipermeable membrane from a less concentrated solution into a more concentrated one following a concentration gradient. If water moves out of the cell, the cell will shrink. If water moves into the cell, the cell may swell or even burst. In plant cells, the presence of a cell wall prevents the cells from bursting, but pressure does eventually build up inside the cell and affects the process of osmosis as at a certain point the cell will not be able to take in more water even though it still has a higher solute concentration.
Osmotic control is a very important aspect that in many cases is crucial, especially in medical procedures in which it prevents damage to cells and tissues. In fact tissues and organs to be used in medical procedures must be bathed in a solution with the same osmolarity as the cytoplasm to prevent osmosis.

Educated guess

The potato immersed in the hypotonic solution will report an increase in mass, the potato immersed in the hypertonic solution will report a decrease in mass, and the potato immersed in the isotonic solution will not report a change in mass

Variables

Dependent variables	Independent variables	Controlled variables
Final mass of potato	Concentration of saline solution	Amount of time the potatoes are kept in the solution (60 minutes)
		Volume of the solution 100 ml (± 0.5)
		Temperature of the solution (25°C)
		Instruments to measure mass of potatoes

Materials

- Potato
- Knife
- Ruler
- Kitchen scale (± 0.05g)
- Chopping board
- 3 Backers
- Salt
- Distilled Water
- Termometer
- Potato peeler
- Sugar
- Timer

Fig. 1 —> Cutting the potatoes

Method

Peel the potato completely and accurately, and remove any eventual unkempt piece. Then accurately cut three slices of 0.75 centimetre thick and other three slices 2.5 centimetres thick. Measure and annotate the mass of each slice of potato with the kitchen scale reporting to the smallest significant figure possible. Place the three backers in line and add 100 ml of distilled water in each of them. Measure the temperature of the water and check if it is approximately the same for all. Prepare the Hypotonic solution by adding to the 100 ml of water, 10 grams of sugar. Do the same for the Hypertonic solution but instead of using sugar use salt. Instead the isotonic solution doesn't need any changes. Label the backers with the type of solution they have inside to avoid future confusion. Immerse one slice of 2.5 centimetres and one slice of 0.75 centimetres thick potato per each backer and start the timer and wait at least 50 minutes to let osmosis completely occur.

Fig. 2 —> Backers with distilled water

Results

Data table:

Type of solution	Initial mass (± 0.01 g)	Final mass (± 0.01 g)	Change in mass (± 0.01 g)
Hypotonic	2.70 g	2.94 g	+ 0.24 g
Hypertonic	2.68 g	2.62 g	- 0.06 g
Isotonic	2.71 g	2.72 g	+ 0.01 g
Hypotonic	8.22 g	8.96 g	+ 0.74 g
Hypertonic	8.24 g	8.03 g	- 0.21 g
Isotonic	8.21 g	8.24 g	+ 0.03 g

Percentage change table:

Type of solution	Calculations (FM * 100 / IM)	
Hypotonic	2.94 * 100 / 2.70	+ 8.9%
Hypertonic	2.62 * 100 / 2.68	- 2.7 %
Isotonic	2.72 * 100 / 2.71	+ 0.3 %
Hypotonic	8.96 * 100 / 8.22	+ 9.0 %
Hypertonic	8.03 * 100 / 8.24	- 2.5 %
Isotonic	8.24 * 100 / 8.21	+ 0.4 %

Discussion

Fig. 3 —> Potatoes immersed in solutions

From the results it can be understood that the osmolarity of a solution is a crucial detail to be controlled as it makes substantial differences in what happens to the cells that have been immersed in that solution. In the case of the isotonic solution, for which the weight should have remained unchanged, probably when the potato was removed, some water remained on top of the potato and as a consequence was included in the measurement of the mass. The potato cells in proportion managed to absorb much more water in the hypotonic solution than what was lost in the hypertonic solution, and this can be justified with the fact that the potato used started with a small amount of water inside the cells, so its capacity to lose it afterwards was restricted.

Conclusion

The educated guess which told that the potato immersed in the Hypotonic solution would have increased in mass, that the Hypertonic solution would have decreased in mass, and that the Isotonic solution would have remained unchanged was substantially correct as the isotonic solution in the end did change, but considering the change was very slight and the possible incorrect measurement, it can be said that the data confirmed the educated guess.

Evaluation

This experiment in total was mostly successful and the data reported were precise and in line with what thought. Even though the way the experiment was carried out can be greatly improved in various manners. Firstly and most importantly, the equipment used to measure the masses of the potatoes could have been more precise, in this way the quality and precision of the data reported and of the calculations done would have been better. Secondly, instead of using 3 backers with different sizes and no labels, by using more professional ones, the quantity of distilled water poured in each of them would have both been more quick and precise.

References

- https://www.bioknowledgy.info/14-membrane-transport.html