**Osmosis and Diffusion in Plant and Protist Cells**

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Introduction

Osmosis and diffusion are critical processes that regulate cellular function and homeostasis. Diffusion refers to the passive movement of molecules from a region of higher concentration to a lower concentration, following the concentration gradient. Osmosis is a special case of diffusion, involving the movement of water molecules across a semi-permeable membrane to balance solute concentrations between intracellular and extracellular environments (Alberts, 2017). These processes are vital for maintaining proper hydration and solute balance in both plant and protist cells.

Plant cells depend on osmosis to sustain turgor pressure, which helps maintain their structural integrity. In a hypotonic solution, water enters the cell, causing the vacuole to expand and press against the cell wall, resulting in a firm structure. However, in a hypertonic solution, water leaves the cell, leading to plasmolysis, where the plasma membrane pulls away from the cell wall, causing the plant to wilt (Raven, 2020). Unlike plant cells, protists lack rigid cell walls and must regulate water balance through specialized structures like the contractile vacuole, which actively expels excess water to prevent bursting in hypotonic environments.

Osmosis and diffusion are fundamental processes in biological systems that regulate the movement of molecules across cell membranes. Diffusion is the passive movement of molecules from an area of high concentration to an area of lower concentration, whereas osmosis specifically refers to the movement of water molecules across a semi-permeable membrane (BIO 1120 A Laboratory Perspective, p.30). These processes are essential for maintaining cellular homeostasis, especially in plant and protist cells.

Plant cells rely on osmosis to maintain turgor pressure, which keeps them structurally stable. In contrast, protist cells, such as amoebas, regulate water balance through specialized organelles like the contractile vacuole. This experiment examines osmosis in plant cells using potato samples in varying glucose solutions and observes osmoregulation in protist cells under a microscope.

This experiment aimed to investigate the effects of osmosis in plant cells by measuring mass changes in potato samples exposed to different glucose concentrations. Additionally, the process of osmoregulation in protist cells was observed microscopically to examine how contractile vacuoles function in maintaining water balance. The research question guiding this experiment was: How do different solute concentrations affect water movement in plant and protist cells? The hypothesis stated: If plant cells are placed in a hypertonic solution, they will lose mass due to water efflux, while hypotonic solutions will cause mass gain. In protists, the contractile vacuole will expel more water in hypotonic environments to prevent cell lysis.

Materials and Methods

Reagents and Equipment

* 7 test tubes
* Glucose solutions (0.0 M, 0.2 M, 0.3 M, 0.4 M, 0.5 M, 0.6 M, 0.8 M)
* 5 mL re-pipettors
* Cork borer
* Potato samples
* Petri dish
* Paper towels
* Microscope
* Clean microscope slide
* Coverslip
* Stained amoeba sample

Experimental Procedure

Part 1: Osmosis in Plant Cells

Potato samples were prepared using a cork borer to ensure uniform size. The initial mass of each sample was recorded before placing them into test tubes containing different glucose solutions. Samples remained in the solutions for 30 minutes to allow osmosis to occur. Afterward, they were removed, blotted dry, and reweighed to determine mass changes. The percent change in mass was calculated to assess water movement.

Part 2: Osmoregulation in Protist Cells

A stained amoeba sample was prepared on a microscope slide and observed under high magnification. Cellular structures, including the nucleus, pseudopodia, and contractile vacuole, were identified. The frequency of vacuole contractions was recorded to assess the amoeba’s osmoregulatory response in different environments.

Results

Osmosis and Diffusion in Potato Cells

The results indicated that potato samples in hypotonic solutions (0.0 M, 0.2 M,0.8M) gained mass, while those in hypertonic solutions (0.6 M) lost mass. The sample in 0.5 M glucose experienced the highest mass gain (37.9%), while the sample in 0.6 M glucose showed the greatest mass loss (-5.88%).

Table 3.11: The weight of five potato samples exposed to solutions with different molar concentrations of glucose.

|  |  |  |  |
| --- | --- | --- | --- |
| Glucose(M) | Initial Weight(g) | Final Weight(g) | Percent Change |
| 0 | 1.4 | 1.5 | 7.14 |
| 0.2 | 1.43 | 1.49 | 4.2 |
| 0.3 | 1.99 | 2.02 | 1.5 |
| 0.4 | 1.44 | 1.46 | 1.38 |
| 0.5 | 2.11 | 2.91 | 37.9 |
| 0.6 | 1.36 | 1.28 | -5.88 |
| 0.8 | 1.03 | 2.05 | 99.02 |

Osmosis and Diffusion in Protist Cells

Table 3.2: Size of Vallisneria Cells after Treatment

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Condition | Initial Average Size of Vallisneria Cells in 1 row | Average Size of Cells after 10 minutes | Average Size of cells after 20 minutes | Average Sizes of cell after 30 minutes | Average Size of cell after recovery |
| Water | 64.286 | 64.286 | 64.286 | 64.286 | 64.286 |
| %Salt (5%) | 112.5 | 60 | 67.857 | 50.625 | 60 |
|  |  |  |  |  |  |

**Conclusion**

This experiment confirmed the principles of osmosis and osmoregulation in plant and protist cells. The data supported the hypothesis, demonstrating that potato cells in hypotonic solutions gained mass due to water influx, while those in hypertonic solutions lost mass due to water efflux. The estimated isotonic point occurred around 0.3-0.4 M glucose, where minimal mass change was observed.

In protists, the contractile vacuole actively expelled water in hypotonic conditions to maintain homeostasis, preventing cell lysis. This mechanism is essential for freshwater protists, as their environment constantly drives water into the cell. The observed results align with prior research on cellular water balance (Alberts, 2017).

These findings highlight the importance of osmosis in biological systems. Future research could examine how temperature or different solutes (e.g., NaCl) influence water movement. Additionally, studies on protists in extreme environments could provide further insights into adaptations for osmoregulation.

**References**

Alberts, B., Johnson, A., Lewis, J., Raff, M., Roberts, K., & Walter, P. (2017). *Molecular Biology of the Cell* (6th ed.). Garland Science.

Raven, P. H., Evert, R. F., & Eichhorn, S. E. (2020). *Biology of Plants* (8th ed.). W. H. Freeman.

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