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BIO 2311 Lab
Wed 6:00-8:30 pm

Diffusion of Water, Glucose, NaCl and Sucrose through a Dialysis Bag

Background:[i]

Diffusion is the movement of substance from an area of high concentration to an area of low concentration until the concentration gradient is eliminated. Diffusion often occurs in our cells. The cell membrane is a selective membrane that is permeable to lipids and has channel proteins that allow diffusion to small soluble molecules. This permeability allows these specific molecules to pass into and out of the cell depending on the concentration gradients. However, the cell membrane is not permeable to larger non-lipid molecules, as a result these molecules can't diffuse into and out of the cell unless specifically transported by a carrier mechanism.

Osmosis is the diffusion of water, and it occurs across a semi-permeable membrane in response to differences in solute concentration. Osmotic solutions (solutions in which osmosis occurs) can cause the cells to shrivel (crenation) or swell/burst (hemolysis). There are three types of osmotic solutions: hypertonic (concentration of solute outside the cell is higher than inside), isotonic (concentration inside and outside is the same), and hypotonic (concentration outside is lower than inside).

Purpose:

The purpose of this lab was to determine whether osmosis and diffusion occurs across a dialysis bag with different combinations of solutions inside and outside the bag. By doing this, the permeability of the dialysis bag to different molecules can be determined. Additionally, the end results of osmosis and diffusion can be observed.

Hypothesis:

The dialysis bag will lose water weight in the hypertonic solutions and gain water weight in the hypotonic solutions. No weight changes will be present in the isotonic solutions. As per the permeability of the dialysis bag, it is hypothesized that is it permeable to glucose, and sodium but not permeable to sucrose because it is slightly larger molecule.

Materials:

- 4 Dialysis bags/sacs
- 4 beakers
- 20 mL of each of the following solutions:
    - 20 % glucose solution
    - 10 % NaCl solution
    - 40 % glucose solution
    - 40 % sucrose solution
- A volume equal to half a beaker, of each of the following:
    - Distilled water (X3)
    - 40% glucose solution

Procedure:

1. Gather materials
2. Label the 4 beakers 1-4
3. Fill beakers 1,3, and 4 halfway through with distilled water

4. Fill beaker 2 with 40% glucose solution
5. Fill each sack with 20 mL of the following solutions:
    a. Sack for beaker #1: 20% glucose solution
    b. Sack for beaker #2: 40% glucose solution
    c. Sack for beaker #3: 10% NaCl solution
    d. Sack for beaker #4: 40% sucrose solution
6. Measure the weight of each sack and record
7. Place each sack in their representative beakers for 45 minutes
8. Take out the sack, wipe the surface, measure, and record new weight
9. Take 8 test tubes and label them from 1A to 4A, and 1B-4B
10. Takes a sample of each solution in the sack and place them in test tubes A with the number corresponding to their assigned beaker number
11. Takes samples from the solution in the beakers and place them in test tubes B with the number corresponding to the beaker number.
12. For test tubes 1,2 and 4, both A and B, add a benedict's solution and mix.
13. Place the test tubes in boiling water and observe.
14. If the color changes to yellow, green, or brown then the solution is positive for sugar, record the results.
15. For test tubes 3A and B, add silver nitrate solution dropwise.
16. Record any presence or absence of white precipitate. If precipitate present then solution is positive for sodium chloride.

Results:

Table 1: Change in weight

	S1	**S2**	**S3**	**S4**
Weight of sack at time " zero"	7.1 gm	6.9 gm	7.2 gm	7.1 gm
Weight of sack after 45 minutes	8.0 gm	6.9 gm	7.8 gm	8.0 gm
Change in weight:	+0.9 g	0 g	+0.6 g	+0.9 g

Table 2: Test for sugar

1A	Positive
1B	Positive
2A	Positive
2B	Positive
4A	Positive
4B	Negative

Table 3: Test for NaCl

3A	Positive
3B	Positive

Discussion:

According to the results, there was movement of water into the cell for sacks 1, 3 and 4. Beakers 1,3,4 all had distilled water while the sacks had a solution with glucose, NaCl and sucrose in them, respectively. This means that all three sacks had a high concentration of solute inside the cells versus outside, making the solution outside the sack hypotonic. This caused water through osmosis to move from an area of low solute concentration to an area of high solute concentration, leading to the sac

having an increased weight. According to the results, there was no movement of water into the cell for sack number 3. This is because the solution in the beaker, 40% glucose, was exactly the same as the solution inside the sac. Thus, the concentration of solute inside and outside the cell was exactly the same, making the solution outside the beaker isotonic. Since there was no difference in concentration here was no net movement of water, resulting in no weight change. The results of this part of the experiment agree with the hypothesis that hypotonic solution will lead to a weight gain while isotonic will have no weight change.

In order to determine if diffusion of the solutes across the membrane occurred, a sugar and salt test were conducted. The results of the test showed that the solution in beakers 1 and 2 both tested positive for sugar, indicating that the glucose in sacs 1, and 2 has diffused through the membrane to an area of low glucose concentration. Thus, we can conclude that the dialysis bag is permeable to glucose. The results of beaker 4 showed negative for sugar, indicating that no diffusion occurred for the sucrose in sack 4. Thus, we can conclude that the dialysis bag is not permeable to sucrose. This makes sense since sucrose is larger than glucose.

Since beaker 3 had sodium chloride inside the sac, a salt test was conducted. The results showed that the solutions inside beaker 3 was positive for salt, indicating that salt diffused across the dialysis bag membrane to an area of low salt concentration. Thus, we can conclude that the dialysis bag is permeable to salt.

The results for the permeability of the different solutes agree with the hypothesis for this paper.

Conclusion:

In conclusion, the dialysis bag demonstrated the principles by which osmosis and diffusion work. In hypotonic solutions, the dialysis bag gained water weight, indicating movement into the sac. In isotonic solutions, there was no weight gain, indicating no net change in water amount inside the sac.

The results of sugar and salt test indicated that the dialysis bag is permeable to sodium and glucose but not sucrose. There was evidence that the permeable solutes diffused towards areas of lower solute concentration (outside the sac).

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[i] Information was taken from the power point “03-03_pptlect” on Blackboard. The power point covers Chapter 3, part 3 of the Fundamentals of Anatomy and Physiology, sixth edition by Frederick H. Martini.