Abstract:

Osmosis is the diffusion of water across a semi-permeable membrane. This experiment tested osmosis when dealing with different concentrations of salt on the outside of the membrane. If there is a higher concentration of salt on the outside of the membrane, then water will move across the membrane to the outside in order to reduce the concentration of salt. This hypothesis was supported by the data from this experiment because it shows the weight of the potato cores decreased at higher levels of salt concentration.

Introduction:

The purpose of this experiment was to show the relationship between osmosis and the salinity in a solution. Water naturally diffuses across membranes from areas of lower salinity to areas of higher salinity. Osmosis is the net movement of water across a selectively permeable membrane driven by a difference in solute concentrations on the two sides of the membrane. (Bowen, 2000). When the concentration of dissolved salt is greater outside the semi-permeable membrane, the solution is hypertonic and water will diffuse across the membrane from the inside to the outside in order to reduce the salinity outside the membrane (Gross, De Zeeuw & Simpao, 2001). "Water molecules are able to pass through most biological membranes, so salinity imbalances within biological systems are naturally corrected via the diffusion of water across semi-permeable membranes to equalize salt concentrations on both sides of the membrane" (Gross, De Zeeuw & Simpao, 2001). If there is a higher concentration of salt on the outside of the membrane, then water will move across the membrane to the outside in order to reduce the concentration of salt.

Variables:

Independent variable: Salt concentration
Dependent variable: Weight of potato cores
Constants:
Amount of distilled water
Water temperature
Size of potato cores
Type of potatoes
Type of salt
Room temperature

Apparatus:

- 5 Red potatoes
- 1500 mL distilled water
- 15 Plastic cups
- Table salt
- 500 mL beaker
- 100 mL graduated cylinder
- 1 cm diameter corer
- Stir plate
- Permanent marker
- Knife
- Ruler
- Thermometer

Procedure:

Using the permanent marker, 5 cups were labeled 0.0 M, 5 cups were labeled .5 M, and 5 cups were labeled 1.0 M salt. 100 mL was measured in the graduated cylinder and then added to the first cup labeled 0.0 M. This was then repeated for each of the first 5 cups labeled 0.0 M.

14.61g salt was added to a 500 mL beaker. Then, distilled water was added until the solution measured 500 mL. The beaker was then placed on a stir plate and stirred at 400 RPMs for 1 minute until the salt was completely dissolved into the distilled water. Then 100 mL of the solution was measured in a graduated cylinder and added to the first cup labeled .5 M. This was then repeated for all 5 cups labeled .5 M.

29.22 g of salt was added to a 500 mL beaker. Distilled water was added until the solution measured 500 mL. The beaker was stirred on a stir plate at 400 RPMs for 1 minute until the salt was completely dissolved in the solution. 100 mL of the solution was measured in a graduated cylinder and added to the first cup labeled 1.0 M. This was then repeated until all 5 cups labeled 1.0 M were filled with 100 mL of the solution. The thermometer was then used to record any variations in temperature between the cups.

The 1 cm diameter corer was used to create cores in the potato longer than 2 cm. A knife and a ruler were used to create 2 cm cores. This was repeated until 45 cores were created. The cores were separated into groups of 3 and weighed on a triple beam balance. Then, 3 cores were placed in all 15 cups. The cups were placed off to the side for 48 hours.

After sitting for 48 hours, the thermometer was used to measure the temperature of the solution and any variations were recorded. All 15 cups were then drained in the sink. The 3 cores in each cup were blotted to remove excess moisture and weighed on a triple beam balance. The weight was recorded for each cup, noting the change between beginning and ending weight.

Data:

0.0 M Salt				
Tests	Weight Before (g)	Weight After (g)	Change (g)	% Change
Test 1	3.6g	3.7g	+.1g	2.7%
Test 2	3.6g	3.0g	-.6g	-16.6%
Test 3	3.5g	3.8g	+.3g	8.6%
Test 4	3.6g	3.8g	+.2g	5.6%
Test 5	3.6g	3.0g	-.6g	-16.6%
Average	3.6g	3.5g	-.6g	-3.3%

0.5 M Salt				
Tests	Weight Before (g)	Weight After (g)	Change (g)	% Change
Test 1	3.6g	2.3g	-1.3g	-36.1g%
Test 2	3.6g	2.3g	-1.3g	-36.1g%
Test 3	3.6g	2.3g	-1.3g	-36.1g%
Test 4	3.6g	2.2g	-1.4g	-38.1%
Test 5	3.6g	2.0g	-1.6g	-44.4%
Average	3.6g	2.2g	-1.4g	-41.3%

1.0 M Salt				
Tests	Weight Before (g)	Weight After (g)	Change (g)	% Change
Test 1	3.7g	2.3g	-1.4g	-37.8g%
Test 2	3.6g	2.4g	-1.2g	-33.3g%
Test 3	3.6g	2.3g	-1.3g	-36.1g%
Test 4	3.6g	2.5g	-1.1g	-30.6%
Test 5	3.5g	2.5g	-1.0g	-28.6%
Average	3.6g	2.4g	-1.2g	-29.6%

The percentage of change was calculated by dividing the amount of change by the original weight.

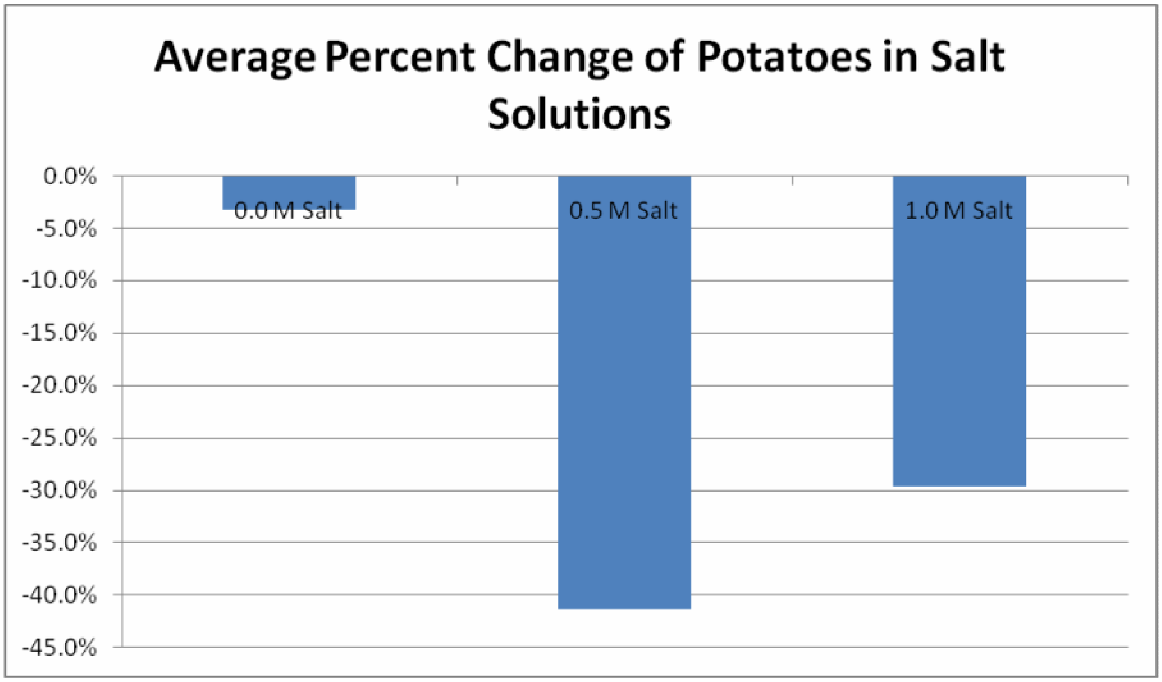
-1.2 g / 3.6 g = .296 = 29.6%

The amount of salt for each solution was calculated by finding the molecular weight of table salt, NaCl (Sodium chloride). This number, 58.44, was then multiplied by 500 to give 29,220. 29,220 was divided by 1000 to give the amount of salt in grams to add to the 1.0 M solution. This is a 5.8% salt solution.

$$\frac{58.44}{1000} \; x \; \frac{x}{500}$$

In order to find the amount of salt to add to the .5 M solution, the molecular weight, 58.44, was multiplied by 500. This number, 29,220 was then divided by 2000 to give the amount of salt in grams to add to the .5 M solution. This is a 2.9% salt solution.

$$\frac{58.44}{2000} \; x \; \frac{x}{500}$$



Discussion:

The hypothesis that the weight of the potato cores would decrease when salt was added to the concentration was supported from this experiment. The data from both the 0.5 M solution and 1.0 M solution shows that the weight of the potato core decreased by about 41.3% and 29.6%, while the 0.0 M solution only decreased by about 3.3%. This proves that the water diffused across the potato membrane in order to reduce the concentration. I do find it interesting that the .5 M solution actually decreased more in average weight than the 1.0 M solution did, although I do not have an explanation for this.

This experiment could have been improved by using a more accurate scale. An electronic scale might have been able to measure the salt more precisely. Also, the excess moisture of the potatoes was taken off after they sat in the solution by blotting them on a paper towel. There was no way to measure this, and some potato cores may have had more moisture taken off than others, skewing results. However, I do not believe this would have affected the results enough to change the conclusion that the hypothesis was supported by this experiment.

I would be interested to test how different types of salt, such as sea salt or kosher salt, affect the osmosis in potato membranes. I would like to redo my first group of 0.0 M solution because 2 of the results from those cups were abnormal and unexpected. While 3 of the cups gained a little bit of weight (approximately .2 g), 2 of the cups lost .6 g of weight. This seems very inconsistent and it leads me to believe that I made an error in my tests.

Acknowledgements:

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Literature Cited:

Gross, C., De Zeeuw, J., & Simpao, T. (2001, April 27). *Awesome Osmosis.* Retrieved from http://marinediscovery.arizona.edu/lessonsS01/blennies/2.html

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