Osmosis and Dehydration in Organisms

Water Movement Across the Cell Membrane

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Abstract:

Three different solutions are used in this experiment to understand the relation and process of osmosis and dehydration within bok choy cells. The first solution is just water, which would be served as the control group; and two experimental groups, experimental group 1 and 2 contain salt with the ratio of 20 and 40 grams of salt per liter of water respectively. Our result shows that the bok choy of the control group has a 19.51% increase in mass. While the experimental group 1 and group 2 has a decrease in mass, 15.17% and 10.46% respectively. Furthermore, the taste of the Bok choy in the experimental groups become salty, experimental group 2 is slightly saltier.

Introduction:

Osmosis is a form of diffusion, the process in which cells uptake or lose water; water molecules move across cells' membrane to a location with a higher concentration of solute, which in this experiment is the salt. *Brassica rapa subsp. Chinensis* (commonly known as Bok choy), just like all other living organisms have cells and tissues that are composed of mostly water. Therefore, organisms' cells will lose water to the saltier (hypertonic) outside environment, causes it to dehydrate and shrink, which is also called plasmolysis. In addition, organisms' cells will gain water from the freshwater (hypotonic) solution, allows it to gain mass. Due to another form of diffusion, organisms will also gain salt, due to the higher salinity of the solution, the salt molecules would be moving into the plant cells, which contains less salt content. Thereby, the organisms that are put in the experimental groups' solution, will become salty.

Hypothesis:

When Bok choy is emersed in freshwater solution, it was predicted that this organism will gain water which meant that it would gain mass. Furthermore, it was hypothesized that the organism will also become less fresh, that some part of the plants would shrivel due to being soak in solution. However, it was also believed to have no change in flavor.

Whereas, the bok choys that are soaked in the two salt-solution, are predicted to lose mass and shrink in size, because the water within the cells of the bok choys will flow to the to the high solute concentration solutions. In addition, it was hypothesized that these two

experimental units will become salty, as the salt molecules move from a higher concentration to a lower concentration which is the cells of bok choys, causes the change in taste.

Materials and Methods:

Materials:

The materials use for this experiment are table salt (Sodium Chloride), beakers, and vegetables such as: Bok Choy, Carrot, Cucumber, Green bean, Potato, and Zucchini.

Methodoly/Lab Procedure:

Name of the Organism: Bok choy

Scientific Name: *Brassica rapa subsp. Chinensis*

Procedures To Prepare The Three Solutions

In this experiment, the organisms will be emersed in three different solutions, freshwater and two saltwater solutions. Thereby, we start by filling three beakers with filtered water, one will be kept for the control group. While, the other two will be added with salt based on the 20g/L and 40g/L of salt ratio. It is essential to distinguish the different solutions, so we labeled the solution as water, 20g/L (Experimental Group 1), and 40g/L (Experimental Group 2) according to what solution it is. To make sure that all the salt dissolves in the solvent, we would have to stir the two solutions of the experimental groups.

Procedures To Prepare The Vegetable: Bok choy

Cut bok choy into five pieces based on its different leaf layers (Leaf Layers of Bok choy Appendix figure.1): one for tasting, one for touching, one for putting in the fresh water, and the other two for the experimental group. For the three pieces that will be put in the solution, we measure their pre-weights, each piece will be weighed in triplicate and labeled as in which solution it go in.

Result:

Table.1

Brassica rapa subsp. Chinensis	Concentration of Salt Solution (g/L)		
	0 g/L	20 g/L	40 g/L
Initial Mass of Vegetable Tissue (g)	4.1g	4.83g	5.1g
Final Mass of Vegetable Tissue (g)	4.9g	4.1g	4.57g
Percent Change in Vegetable Tissue Mass (%)	Increase by 19.51%	Decrease by 15.17%	Decrease by 10.46%

Table.2

Organism		Initial Mass (g)	Final Mass (g)	Percent Change in Mass (%)
Beans	Salt Concentration of 0 g/L	2.367g	2.733g	Increase by 15.50%
	Salt Concentration of 20 g/L	3.200g	2.900g	Decrease by 9.40%
	Salt Concentration of 40 g/L	2.867g	2.800g	Decrease by 2.30%
Bok Choy	Salt Concentration of 0 g/L	4.10g	4.90g	Increase by 19.51%
	Salt Concentration of 20 g/L	4.83g	4.10g	Decrease by 15.17%
	Salt Concentration of 40 g/L	5.10g	4.57g	Decrease by 10.46%
Carrot	Salt Concentration of 0 g/L	26g	28g	Increase by 7.70%
	Salt Concentration of 20 g/L	37g	37g	0% Change
	Salt Concentration of 40 g/L	34g	33g	Decrease by 2.90%
Cucumber	Salt Concentration of 0 g/L	13.67g	15.30g	Increase by 14.39%
	Salt Concentration of 20 g/L	13.33g	11.87g	Decrease by 11%
	Salt Concentration of 40 g/L	13.53g	11.20g	Decrease by 17.24%
Potato	Salt Concentration of 0 g/L	18g	20g	Increase by 11.11%
	Salt Concentration of 20 g/L	19g	15.33g	Decrease by 19.30%
	Salt Concentration of 40 g/L	19g	14.67g	Decrease by 22.81%
Zucchini	Salt Concentration of 0 g/L	8g	10.30g	Increase by 29.16%
	Salt Concentration of 20 g/L	8g	7g	Decrease by 12.50%
	Salt Concentration of 40 g/L	8g	7g	Decrease by 12.50%

Table.3

Solution		Physical Appearance	Tactile Observations	Taste Observations
Freshwater	Predictions	Gain water	The pithy will become more visible	No change in taste
	Result	Doesn't change any appearance but become heavier	- When break the stem more water comes out - the stem is smoother	- More water when bite - the leaf become more bitter - there was not more strong aftertaste in the stem
Salt Concentration of 20 g/L	Predictions	Lose water and shrink	Hard to break the stem	Become salty
	Result	- The leaf and stem become soft - shriveled and can't support itself - the color turns a darker shade of green	- take more pressure to break the stem	- Become a little salty but barely able to taste it - cut out some the aftertaste - a little more water when bite - not as bitter
Salt Concentration of 40 g/L	Predictions	Lose water and shrink	Hard to break the stem	Become salty
	Result	- The leaf and stem become soft - shriveled and can't support itself - darker green (more than the result of the experimental group 1)	take more pressure to break the stem (more than the organism in the experimental group 1)	- salty -can barely taste the aftertaste - not as bitter (but more bitter than the result of experimental group 1)

Figure. 1

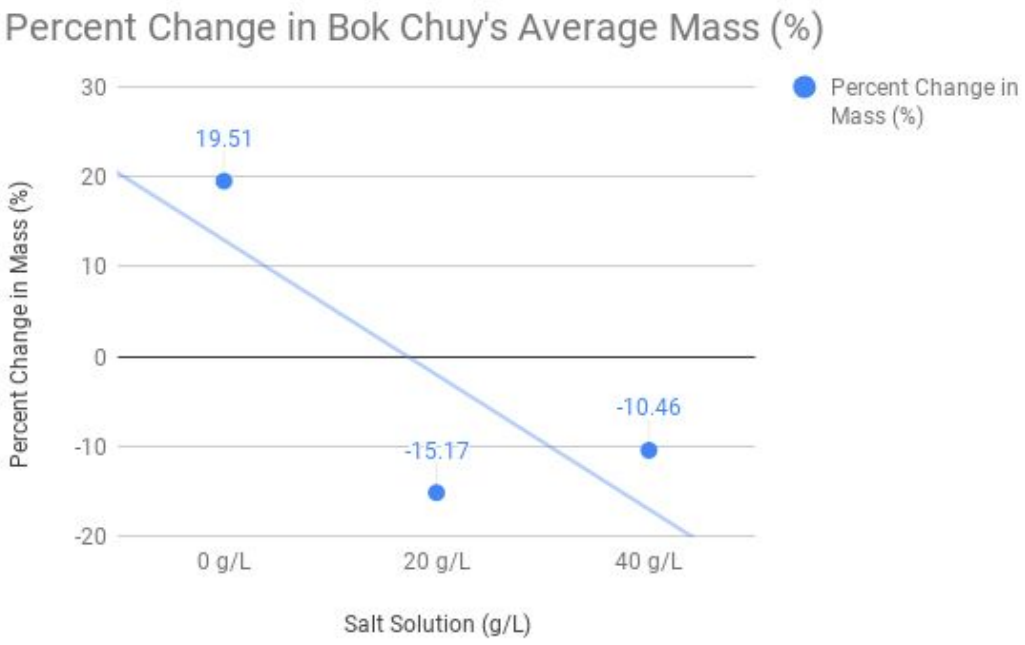
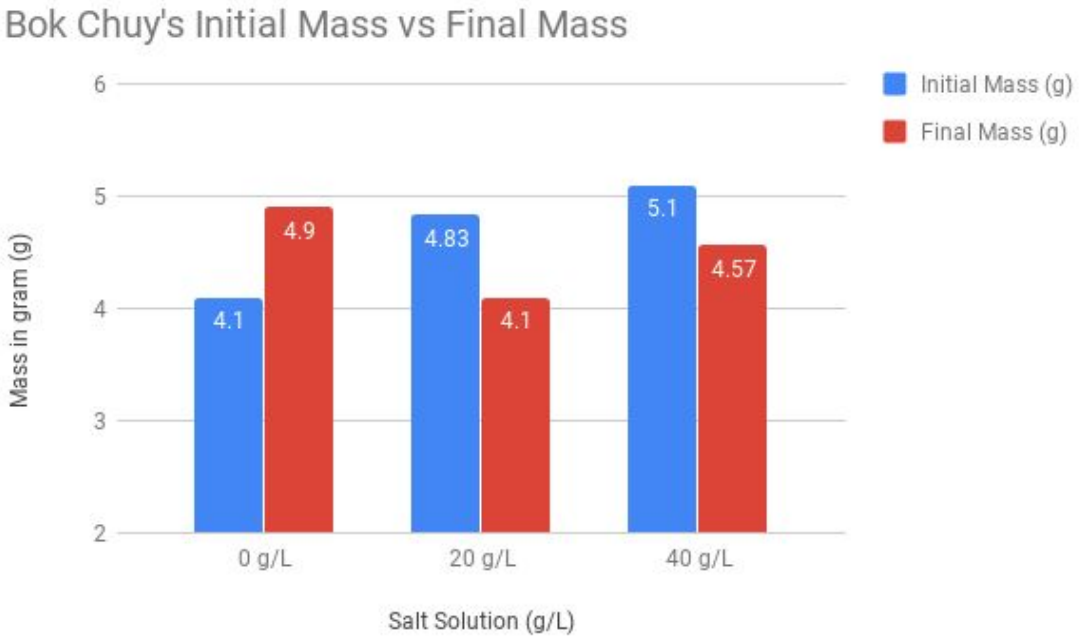


Figure. 2



Based on Table.1 bok choy that is soaked in freshwater increases the weight by 19.51%. While the bok choys of the other two solution decrease in weight by 15.17% and 10.46%, experimental group 1 and 2 respectively. According to Figure.1, based on this line of best fit, we can see that

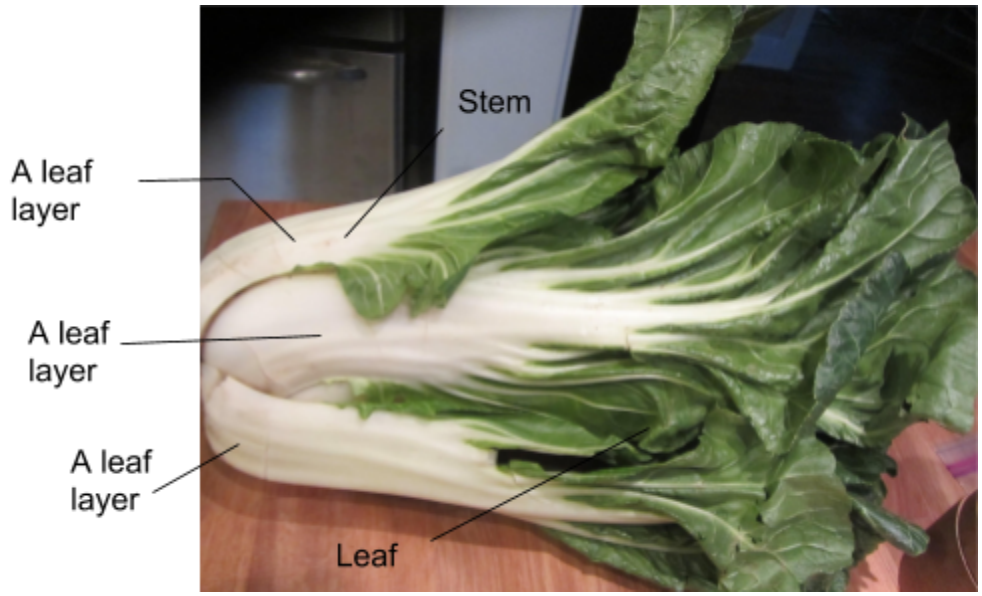
as we add more salt to the solution, the weight of the organism will decrease. Data on Table. 2 shows that among the organisms that soaked in freshwater solution, zucchini has the largest percent change in mass, this organism has increased by 29.16%. Whereas, carrot that is within this same solution increase only by 7.7%. Furthermore, for the experimental group with the solution of 20g/L of salt, potato has the largest change in weight, and carrot has the lowest change; decreases by 19.7% and 0% respectively. For, the last solution with the concentration of 40g/L of salt, potato has the largest change in weight and beans have the lowest change in weight, decreases 22.81% and 2.3% respectively. According to Table.3, the result shows that over the three various solutions, bok choy has changed small aspects of its appearance, tactile, and tastes, when take out from the solution. Within all three of the solutions, the result shows that, when take taste the organism, there is a reduction of the aftertaste within bok choy stem (Leaf and Stem of Bok choy Appendix figure.1), while the leaf becomes more bitter compares to the pre-prediction taste. In addition, when breaking the stem, the bok choys from the two experimental groups require more pressure to break it.

Discussion:

According to the graphs in Figure.2, the predictions regarding the percent change in mass of the organism over the various solutions are correct. We predict that the mass of the organism in freshwater solution will increase, and based on the data, the result shows that the bok choy has increased from the mass of 4.1g to 4.9g. We also predict that the bok choy within the two experimental groups will decrease, which Figure.2 displays that in experimental group 1, the organism has decreased from 4.83g to 4.1g. Whereas, in experimental group 2 shows that it has decreased from 5.1g to 4.57g. Based on Figured.1, we can see a tend within the line of best fit, which shows that as there is more solute concentration, the mass of the organism decreases. Thereby, showing that water movement is based on the concentration of solute. However, there are minor differences in the prediction and the result for taste and appearance of the organism. Like in freshwater, we predict that the pithy of bok choy will become more visible after being soaked, however, the result shows that there isn't in its appearance. Although, the result shows differences between the prediction and the result, these prediction in physical appearance, tactile, and taste, are subjective. Since we all perceive these senses: taste and touch differently, these three observations are not reliable. Despite weight being the most accurate measurement within this experiments, there are possible influences that can affect the data collection process. When we take out the organism from its solution, there are water dipping, therefore we use paper towel to remove those water, even so, there is no clear indication that all those water molecules are being removed or whether will dap the organism to hard and squeeze the water out of the bok coy, which would then affect the mass of the organism.

Appendix:

Figure.1



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