Biology IA
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To find the water potential of the cytoplasm of potato cell *(Solanum tuberosum linnaeus)*

Observation:

1. Potato (*Solanum tuberosum* linnaeus) [1] strips turn into dark colour when it gets oxidized because it exposed to air too long.
2. Potato (*Solanum tuberosum linnaeus*) strips become turgid after putting in the 0.1 mol sucrose concentration for 30 minutes.
3. Potato (*Solanum tuberosum linnaeus*) strips become flaccid after putting in the 0.5 sucrose concentration for 30 minutes.

Raw data:

2.5cm potato (*Solanum tuberosum linnaeus*) strips, cock borer number 1 and number 2

Table 1.1

Mass of potato (*Solanum tuberosum linnaeus*) strips before putting into sucrose solution

Concentration of sucrose solution/mol dm^3	Trial	Mass of potato (*Solanum tuberosum linnaeus*) strips before adding into sucrose solution/g (±0.01g)	Mass of potato (*Solanum tuberosum linnaeus*) strips after adding into sucrose solution/g (±0.01g)
0.1	1	0.53	0.58
	2	0.55	0.59
	3	0.58	0.62
	4	0.57	0.61
	5	0.57	0.61
0.2	1	0.56	0.58
	2	0.58	0.61
	3	0.57	0.60
	4	0.63	0.65
	5	0.65	0.66
0.3	1	0.56	0.55
	2	0.58	0.58
	3	0.57	0.57
	4	0.72	0.71
	5	0.75	0.74
0.4	1	0.62	0.60
	2	0.66	0.64
	3	0.60	0.59
	4	0.55	0.54
	5	0.60	0.58
0.5	1	0.61	0.56
	2	0.61	0.57
	3	0.70	0.66
	4	0.60	0.57

	5	0.60	0.56

Processing data:

$$\frac{\text{Final Mass} - \text{Initial mass}}{\text{Initial mass}} \times 100\% = \%\text{ change in mass}$$

Table 1.2
% Change in mass of the potato (*Solanum tuberosum linnaeus*) strips after

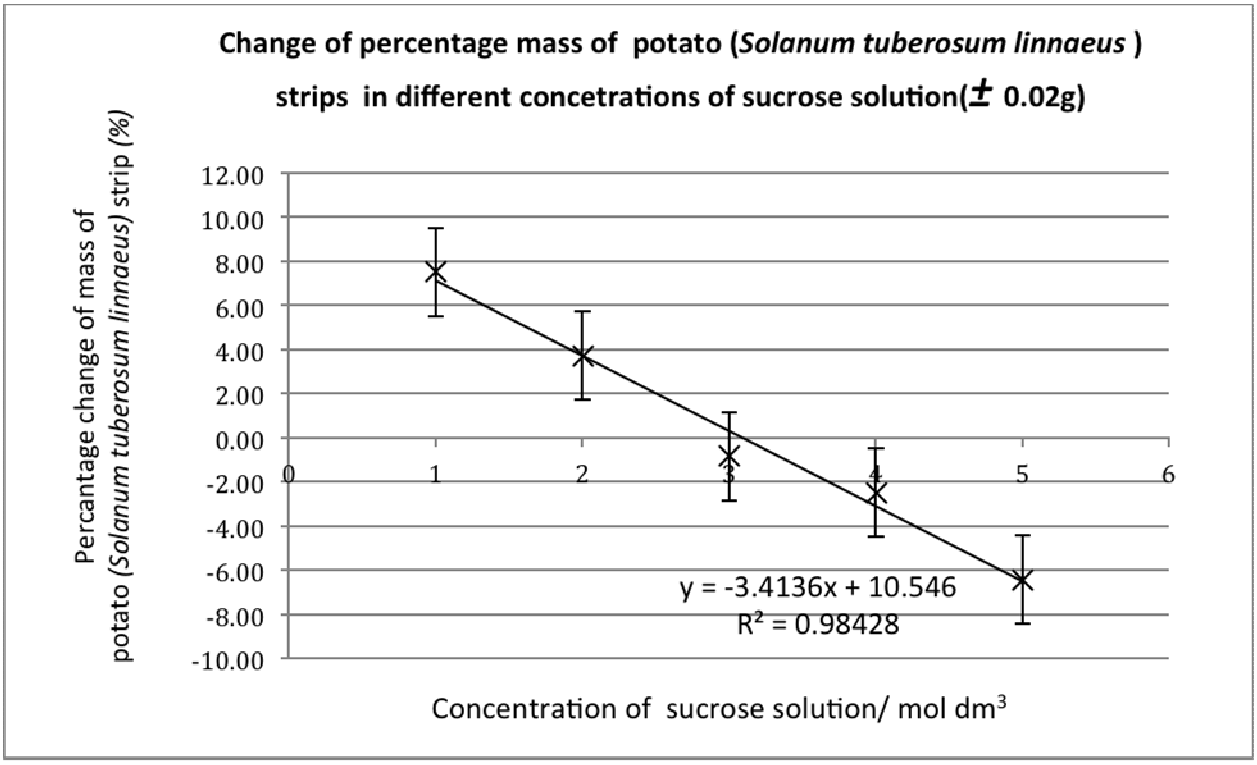
Concentration of sucrose solution/mol dm^3	Trial	Change of mass of potato *(Solanum tuberosum linnaeus)* strips/g (±0.02g)	% Change of mass of the potato *(Solanum tuberosum linnaeus)* strips/%
0.1	1	0.05	9.43
	2	0.04	7.27
	3	0.04	6.90
	4	0.04	7.02
	5	0.04	7.02
0.2	1	0.02	3.57
	2	0.03	5.17
	3	0.03	5.26
	4	0.02	3.17
	5	0.01	1.54
0.3	1	-0.01	-1.79
	2	0.00	0.00
	3	0.00	0.00
	4	-0.01	-1.39
	5	-0.01	-1.00
0.4	1	0.02	-3.23
	2	-0.02	-3.03
	3	-0.01	-1.00
	4	-0.01	-1.82
	5	-0.02	-3.33
0.5	1	-0.05	-8.20
	2	-0.04	-6.56
	3	-0.04	-5.71
	4	-0.03	-5.00
	5	-0.04	-6.67

putting into sucrose solution

Table1.3

	Potato (*Solanum tuberosum linnaeus*) strips				
Concentration of sucrose solution/ mol	0.1	0.2	0.3	0.4	0.5
Mean value of % change in mass/%	7.53	3.74	-0.84	-2.48	-6.43
Standard Deviation of %change of mass	1.07	1.55	0.81	1.03	1.20

Figure1.1



Y = -3.4136x + 10.546
0 = -3.4136x + 10.546
x= 3.09

	Potato (*Solanum tuberosum linnaeus*) strips in 0.1 and 0.2 mol	Potato (*Solanum tuberosum linnaeus*) strips in 0.2 and 0.3 mol	Potato (*Solanum tuberosum linnaeus*) strips in 0.3 and 0.4mol	Potato (*Solanum tuberosum linnaeus*) strips in 0.4 and 0.5mol
df	4	4	4	4

P value	0.0114	0.0010	0.0240	0.004
T value	4.4300	8.6664	3.5409	10.6236
Ho	Reject	Reject	Reject	Reject

Concentration of sucrose solution is 0.309 mol≈ 0.3mol when water potential of potato (*Solanum tuberosum linnaeus*) strips is equal to water potential of sucrose solution.

Table 1.4
Results of T-test[2]
H_o means "no significant difference between two sets of value"

If:

- **P=1**, it means the two sets of data, are exactly the same
- **P=0** it means the two sets of data, are not the same at all.
- P< 0.05, we reject H_o (null hypothesis), which means there are significant difference between two set of values
- p>0.05, we accept H_o (null hypothesis), which means there are no significant difference between two set of values
- T value < critical value, we accept Ho (null hypothesis)
- T value > critical value, we reject Ho (null hypothesis)

My results:

Concentration of sucrose solution/mol dm^3	T value> critical value
0.1M and 0.2M	4.4300> 2.78
0.2M and 0.3M	8.6664> 2.78
0.3M and 0.4M	3.5409> 2.78
0.4M and 0.5M	10.6236> 2.78

I rejected Ho for all of the values above because my T value is larger than critical value.[4]

Conclusion:

The aim of this experiment is to find the water potential of cytoplasm of potato (*Solanum tuberosum linnaeus*) strips. Osmosis is a passive movement of molecules of water from area of low solute concentration to high solute concentration through a partially permeable membrane. When there is no net movement between water molecules, the water potential of solvent and the water

potential of the solute are equal.

The range of literature value of water potential is from 0.24mol to 0.31mol, which estimate to be -680 to -860 kPa[5] because 0.24mol has water potential -680kPa and 0.30 mol has water potential -860 kPa. From my results (refer to figure 1.1), I found that concentration of sucrose is in 0.309mol ≈ 0.3mol and water potential (ψ) would be -860kPa[3] is in Isotonic which is when water potential of potato (*Solanum tuberosum linnaeus*) strips and water potential of sucrose solution is equal. My results are in the range of the literature value, which means my results are quite accurate.

From this experiment I found that potato (*Solanum tuberosum linnaeus*) strips decrease in mass as well as in turgidity from concentration of 0.1 to 0.5mol. Potato (*Solanum tuberosum linnaeus*) strips put in 0.1 are the hardest and most turgid among others. Potato (*Solanum tuberosum linnaeus*) strips put in 0.5mol are the softness and most flaccid among others.

Therefore, masses of potato (*Solanum tuberosum linnaeus*) strips in 0.1 mol of sucrose concentration gained the most in mass since sucrose solution in 0.1M is less concentrated, therefore there is low sucrose concentration and more water potential, which is in hypotonic, therefore water move from high water potential to low water potential, which is from sucrose solution to potato (*Solanum tuberosum linnaeus*) strips. On the other hand, sucrose solution in 0.5M is more concentrate; therefore there is high sucrose concentration and less water potential, which is in hypertonic therefore water move from low water potential to high water potential, which is from potato (*Solanum tuberosum linnaeus*) strips to sucrose solution therefore masses of potato (*Solanum tuberosum linnaeus*) strips decrease.

For this experiment we use paired T-test because this is a “before and after” experiment. We calculate the mean; standard deviation then do paired T-test for potato (*Solanum tuberosum linnaeus*) strips find out if there is a significant difference between potatoes (*Solanum tuberosum linnaeus*) strips between concentration of 0.1M and 0.2M, 0.2M and 0.3M, 0.3M and 0.4M, 0.4M and 0.5M.

From my results in table 1.4, they show the T and P value that I get after doing the paired T-test. All of my results are highly significant since all of the T value is larger than critical value (2.78). When T value is larger than critical value, we reject Ho (null hypothesis). Hence, it also means there is a significant difference of %change of mass between 0.1M and 0.2M, 0.2M and 0.3M, 0.3M and 0.4M, 0.4M and 0.5M.

Also from table 1.3 we can see the standard deviation of potato (*Solanum tuberosum linnaeus*) strips in 0.1M, 0.2M, 0.3M, 0.4M and 0.5M. My results show a low standard deviation, it means there is highly significant difference between two sets of data.

Evaluation:

My results are highly significant because all of my results rejected Ho (null hypothesis) and I rejected Ho because my results show T value is larger than critical value (refer to table 1.4). Nevertheless, errors still occur during the

experiment. From the error bars in figure 1.1, we can see error bars of 0.2M and 0.3M, 0.4M and 0.4M and 0.5M are not overlapping at all, 0.1M and 0.2M are a bit overlapping; 0.3M and 0.4M have a large part of overlapping in error bars.

There are also some external factors, which we cannot control, for example temperature and humidity in the classroom would affect the rate of the experiment.

Uncertainties in the experiment may be the length of potatoes (*Solanum tuberosum linnaeus*), which is (0.2/2.5) x 100%= 8%

Every time, we use cork borer to push the potatoes (*Solanum tuberosum linnaeus*) strip out, they may different water potential, because some places in potato (*Solanum tuberosum linnaeus*) may have more water potential and some area may has lower water potential. Thus, it would be lead to an unfair test if every potatoes (*Solanum tuberosum Linnaeus*) have different water potential because this will give different results, which lead to inaccuracy.

I think we can only improve above error by doing the experiment for three times or more because we cannot find five potato (*Solanum tuberosum Linnaeus*) strips with the same water potential for each concentration. However, we can compare the results together or find the average then see which results give a more significant difference to get a more accurate answer.

Since potato (*Solanum tuberosum linnaeus*) strips will get oxidized if it exposes to air too long, therefore we need to prevent water evaporated. To make a fair test, we should start the experiment as soon as we can once we have pushing out 5 pieces of potatoes (*Solanum tuberosum linnaeus*) strips, so it can avoid water evaporated from potato (*Solanum tuberosum Linnaeus*) strips, make a fair test and get a more accurate answer.

Another possible error may occur when we took out the potato (*Solanum tuberosum Linnaeus*) strips from the sucrose solution and dry them on the tissue paper because every time we use different forces and sometimes water may lose if we press too hard. To improve it, I think we can repeat the experiment for three times or more then we can find the average and compare the results to get a more accurate answer.

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[1] http://www.shgresources.com/id/symbols/vegetable/
[2] http://www.graphpad.com/quickcalcs/ttest1.cfm
[3] http://dl.clackamas.edu/ch105-04/calculat.htm
[4] http://www.ruf.rice.edu/~bioslabs/tools/stats/ttable.html
[5] http://biology.clemson.edu/bpc/bp/Lab/110/osmosis.htm