All Students
IB Biology
Period 3

KEEP IN MIND, YOUR LAB REPORT WILL NOT LOOK EXACTLY LIKE THIS. IT DEPENDS ON YOUR METHOD AND TYPE OF DATA COLLECTED

DESIGN:

Title The Effect of Various Sucrose Solutions on the Osmosis Rate of Russet Potatoes (*Solanum tuberosum)*

Introduction

The aim of this investigation is to determine the rate of osmosis of potatoes when placed in various sucrose solutions. Osmosis is the passive transport of water across a semipermeable membrane. When cells are placed in various environments osmosis can occur in different directions. This can cause a change in weight. In a usual Russet potato, the water content is about 223 g and the carbohydrate content is 64.1 g. Of that 64.1 g, 52.2 g is sugar, and of that 52.2 g, 1106 mg is glucose. In other experiments of the same nature, the potato lost weight in all sucrose molarities of 0.2 M and higher. The only time the potatoes gained weight was when they were submerged in distilled water, or the 0.0 M, solution.

Question/Defining the Problem

How is the osmosis rate (as determined by the weight change) of Russet potatoes (*Solanum tuberosum)* affected when placed in sucrose solutions of various molarities?

Hypothesis

If the potato is placed in sucrose solutions of 0.0, 0.2, 0.4, 0.6, 0.8 molarity the potato will gain weight. If the potato is placed in a sucrose solution of 1.0 molarity it will lose weight. (alternative hypothesis)

Rationale: Would include hyper/hypotonic information

Selecting Variables

Independent variable- sucrose molarities: 0.0, 0.2, 0.4, 0.6, 0.8, and 1.0 (mol/L)
Dependent variable- the change in weight of the potato (grams)
Controlled variables-
-volume of sucrose solution
-size, shape, age, and species of the potato pieces
-amount of time the potato was submerged in the solution
-the temperature of the solution and the potato
-stability of the container
-accuracy of the sucrose molarities
-same type of equipment for each trial

Controlling Variables

The independent variable was altered by making various sucrose molarity solutions. This was done by using a scale to weigh the specified grams of sucrose for the amount of water. The water was measured using graduated cylinders. The dependent variable will be measured by using a scale, in grams, before being placed in the solution and will be measured after approximately 72 hours. The potato pieces were removed by draining the water and gently using forceps to place the potato on a piece of paper towel to remove excess water drops. Then the potato was placed on the scale to measure the final mass. The sucrose solutions and the potatoes were kept at room temperature. The volumes were controlled using graduated cylinders. Pyrex glass beakers were used for all of the trials. Digital scales were used to measure the amount of sucrose to maintain the accuracy of sucrose molarities.

Materials

-Russet potatoes, baking size, *Solanum tuberosum* (6)
-Size 6 Cork Borer (1)
-Knife (1)
-Cutting board (1)
-25 mL graduated cylinders (6)
-2,000 mL graduated cylinder (1)
-Digital scale (in grams) (1)
-Metric ruler (1)
-Sucrose solutions prepared to the following molarities: 0.2 M (102.710 g of sucrose), 0.4 M (205.404 g), 0.6 M (308.106 g), 0.8 M (410.808 g), 1.0 M (513.51 g) (1.5 L of each solution)
-9 L of distilled water, sucrose, magnetic stirrers, hot plate with stir setting
-150 mL beakers (30)
-Recycled paper towels
-Plastic forceps (6)
-2,000 mL beakers (6)
-Data table in laboratory notebook
-Writing utensil
-Masking tape

Procedure

Six solutions were prepared of the following molarities, 0.0 M, 0.2 M, 0.4 M, 0.6 M, 0.8 M, 1.0 M and stored in 2,000 mL beakers. A cork borer was used to extract a potato core from a Russet potato. The potato core was measured to 2 cm (±0.5 mm). The potato piece was weighed on a digital scale in grams (±0.0005 g) and was recorded in a data table. 40 mL (±0.5 mL) of the 0.0 M solution was measured using a 25 mL (±0.5 mL) graduated cylinder and poured into a 150 mL beaker. The potato core was submerged in the solution for approximately 72 hours. This process was repeated for a total of 5 trials per sucrose solution. The solution was drained out of the beaker and forceps were used to remove the potato and place it on the paper towel. The paper towel was used to blot excess solution from the potato. The potato piece was carefully placed on the digital scale to determine the final mass. This number was recorded in the data table and the data was processed. Caution needed to be used in order to prevent the hands from being cut during cork borer process. After being submerged in sucrose for 72 hours, mold grew on the surface of the potato, therefore caution was needed to not inhale the toxic substance.

DATA COLLECTION AND PROCESSING

Results

Raw Data Collection

Quantitative Data

The Initial and Final Mass of Potatoes Before and After Submersion in Sucrose Molarities (Mol/L+/-0.0025 Mol/L)

Weight of Trials (g +/- 0.0005g)	0.0 M	0.2 M	0.4 M	0.6 M	0.8 M	1.0 M
1st Initial	2.19	2.09	1.99	2.40	2.01	2.12
1st Final	1.92	2.09	1.38	1.68	1.28	1.44
2nd Initial	1.93	2.17	1.98	2.00	2.14	1.92
2nd Final	1.89	2.13	1.47	1.29	1.32	0.96
3rd Initial	3.03	1.83	2.17	1.85	2.12	2.05
3rd Final	2.43	1.87	1.56	1.03	1.36	1.36
4th Initial	2.02	2.26	2.20	1.70	1.78	2.12
4th Final	2.20	2.29	1.75	0.99	1.17	1.71
5th Initial	1.98	2.04	2.23	2.16	1.89	1.94
5th Final	1.53	1.81	1.75	1.10	1.19	1.38

For 0.4, 0.6, 0.8 and 1.0 M all potato pieces lost weight. In 0.2 M, the results stayed relatively the same. Most of the potatoes did not gain weight.

Qualitative Data

- The yellow (0.0M), red (0.6M), and blue (1.0M) solutions grew mold, and had repugnant odors
- The potato cores in the 1.0M and 0.8M were deemed smaller via visual observation.
- Trial 4 for 0.0M was not solid after 72 hours.
- Trial 1 for 0.6M visibly lost weight.

Processing Raw Data

It is important to find the percent change in mass of the potatoes because each potato had a different initial mass.

Percent Change In Mass of Potato

(final-initial) X 100

initial
For Trial 1 of 0.0M:
(1.92-2.19)X100= -12.33%
2.19

It is important to find the mean percent change in mass of the potatoes to find the average for each solution and check for consistency.

Mean Percent Change in the Mass of the Potato

(sum of number of trials)
number of trials
For 0.0 M:
-12.32+ (-2.07) + (-20.13) + 8.91+ (-22.73) = -9.67%
5

It is important to find the standard deviation for all sucrose molarities, in order to determine the variability of the data for each molarity and determine the reliability of the data.

Standard Deviation

-Enter data into lists on TI-83 Plus
-"STAT"
-"CALC"
-"1-Var Stats"
-"2nd, L_1, Enter"
-Standard deviation will be S_x
For 0.0 M:
Enter: -12.32, -2.09, -20.13, 8.91, -22.73 into L_1
S_x= 13.133

It is important to perform a t-test for each data set to determine if the difference in the mean is significant or just due to chance alone.

2-Sample T-Test
-Enter all data sets into lists on the TI-83 Plus
-"STAT"
-"TESTS"
-"2-SampT-Test"
-Select the lists to compare
-Scroll down to "Calculate", "Enter"
-Find the critical t-value, and p-value

For 1.0M compared with 0.2 (control):
0.0-L1
0.2-L2
0.4-L3
0.6-L4
0.8-L5

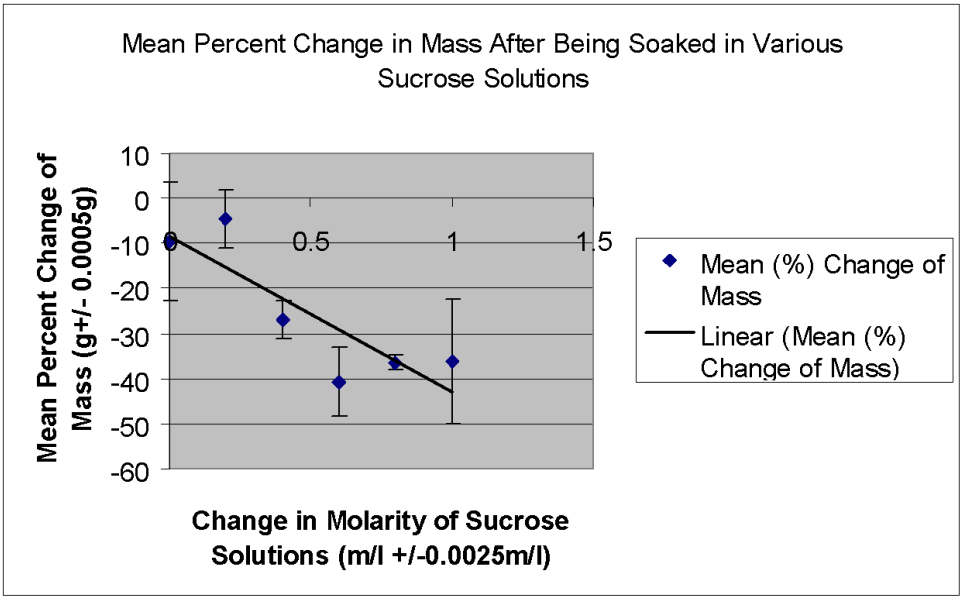
1.0-L6

Degrees of Freedom: 5.666
t-value: 4.609
p-value: 0.004

Data Results for the Effect of Various Sucrose Molarity Solutions on the Osmosis Rate of Potato Cores

Sucrose Molarity of the Solution (Mol/L +/- 0.0025 Mol/L)	Mean Percent Change in Mass (g +/- 0.0005 g)	Standard Deviation	t-Value	p-Value
0.0	-9.67	13.13	0.78	0.47
0.2	-4.55	6.49	control	control
0.4	-26.92	4.38	6.34	3.76
0.6	-40.65	7.68	8.03	4.94
0.8	-36.46	1.67	10.65	2.25
1.0	-36.16	13.89	4.61	0.00

The table above, displays the mean percent change in mass, the standard deviation for each sucrose molarity, and the resulting t-values and p-values for each data set.



The graph above shows that the mean percent change in mass of the potatoes declined as the molarity of the solution increased. It also includes error bars to represent the standard deviation for each data set.

CONCLUSION AND EVALUATION

Conclusion

In the 0.0M solution, the potato lost, on average, 9.67% of its weight, which refuted the hypothesis, which stated that it would gain weight. Overall, all of the sucrose solutions displayed a negative weight change, which also refutes the hypothesis. The potatoes placed in the 0.6M solution lost the most weight by a percent change of 40.65%, while it was expected that the 1.0M solution would have caused the highest percent weight loss. Instead, it was observed that the change in weight for 1.0 M was an average of 36.16%. As molarity increases, the mean percent change of potato mass decreased respectively which demonstrates a negative correlation between sucrose molarity and potato mass. The loss in potato mass demonstrates the concept of osmosis because the movement of water moves toward the hypertonic solution.

Evaluation of Procedure

Overall, the method was successful, however, there were some possible errors that may have affected the data. In the method of this investigation not all trials were started at the exact same time or removed at the same time, which may have allowed slight differences in the change of weight. Using a cork borer allowed for the potato cores to be almost the same size, but each weight was slightly different. Food coloring was used to identify the molarities of the solution, however it wasn't necessary for the for the investigation and could have possibly added mass to the potatoes since the properties of food coloring are unknown. The use of forceps to remove the potatoes from the beakers caused some potatoes to lose water weight, which may have affected the results. Paper towels were used to gently blot excess solution, however, some trials may have included more blotting than others.

Improving the Investigation

Some possible improvements for this investigation would be to record the exact time that each individual trial began and remove each potato exactly 72 hours later using a timer. This would ensure that all potatoes are submerged for the same duration. Using a cork borer is a accurate method for measuring diameter of potato cores, however, after measuring the length each potato core at 2cm (+/- 0.5 mm) each potato core could be weighed on a digital scale, and if there are differences in initial mass, a scalpel could be used to shave off small amounts until they all weigh the same. Instead of using food coloring to identify the sucrose molarities, the beakers could be labeled as specific molarities to avoid any unintended effects on the data. Instead of using forceps to remove the potatoes from the solution, a strainer could be used to catch the potato from the beaker when each is ready to be weighed. The use of paper towel would still be practical for blotting excess solution; however, making sure each potato core is blotted using the exact same method, would better ensure that the potato weight is not affected. Further investigation could be used to supplement the results. For instance, a similar experiment could be conducted for a shorter

duration to avoid the disintegration of the potatoes, while still yielding osmosis results. Some further experimentation could be conducted to determine if other species of potatoes are also affected by sucrose molarities in a similar way. Experiments could also be designed to determine the sucrose molarity of other fruits and/or vegetables. Further experimentation could be conducted to determine if the food coloring could have affected the potato weights. For instance, if only food coloring was used without sucrose, it is possible there could be a change in weight as well.

Works Cited goes HERE!!!