

# Investigating the factor affecting osmosis in potatoes



**ASSIGN  
BUSTER**

Osmosis is diffusion of water molecules moving from a particularly permeable membrane from a high concentration to a lower concentration. The water molecules can pass both ways through the membrane in two-way traffic, but there is a steady net flow of water molecules into the lower concentration of water. In figure 1 is a diagram showing how osmosis takes place.

What affects the rate of osmosis?

There are many factors that can affect the rate of osmosis; these are concentrations of solutions in osmosis, the surface area and temperature. In this specific experiment, there are specific factors that can affect the rate of osmosis.

### 1. Concentration

The concentration of solutions (the water potential) can affect rate of osmosis as more differences between the concentrations of the solutions means a steeper concentration gradient, meaning a faster rate of osmosis. In this particular experiment, if there is more

concentration (potential) of the solution outside the potato than inside, then when osmosis takes place water molecules will go through the permeable membrane into the potato; making the potato heavier and more saturated, while if there is a higher concentration inside the

potato than outside, the opposite will occur, lastly, if the concentration inside and outside are similar or equal, then the rate of reaction will be quite slow or no reaction will occur as then reach equilibrium. Concentration can be

<https://assignbuster.com/investigating-the-factor-affecting-osmosis-in-potatos/>

altered by diluting the solution but keeping it at the same volume, (i. e. from 10cm<sup>3</sup> of sucrose solution, to 2cm<sup>3</sup> of distilled water with 8cm<sup>3</sup> of sucrose solution, equal to 10cm<sup>3</sup> of a mixture.)

## 2. Surface Area

In osmosis with this particular experiment, this is the permeability of the potato, whether the water molecules can easily get through the permeable membrane or not during osmosis, the easier for the water molecules to pass through means faster rate of osmosis. The permeability of the potato can be determined by the age of the potato, as older the potato is the less permeable it is, meaning a slower rate of osmosis.

## 3. Temperature

The higher the temperature is the faster the rate of osmosis, this is because high temperature gives the particles from the solutions more kinetic energy, therefore there they can collide faster and have more successful collisions to give a faster rate of osmosis.

## Hypothesis

The concentration of the surrounding solution affects the length and mass of the potato. This is due to the different concentration of water molecules between the potato and its surrounding solution. When there is a lower concentration inside the potato than its surrounding, the water molecules from the outside will move through the permeable

membrane and into the potato, causing the potato to become saturated, thus adding the weight of the potato at the end of the reaction. However, if the concentration outside is lower than the concentration inside the potato, then water molecules from the potato will move through the permeable membrane and into the outer solutions, thus the potato is unsaturated and its weight is lost at the end of reaction. However, when there is equal amount of water molecules in and outside the potato, then no osmosis will take place as it reaches equilibrium and follows the theory of osmosis. Here is a predict graph and analysis of what will happen as the concentration of sugar solution increases to the rate of osmosis.

1. Potato is saturated and water molecules move at maximum rate of osmosis, therefore it increase the mass of potato.
2. In case of slightly fewer water molecules and lower rate of reaction, therefore only little increase in mass of potato.
3. If the concentration of water molecules in and outside of the potato is at equilibrium, then no net movement and no change in mass.
4. If there are more water molecules inside the potato and moves out of the potato, then the mass will decrease and become unsaturated.
5. More water molecules inside the potato than outside, therefore the potato becomes dehydrated and unsaturated with light weight.

Materials Required:

Apparatus

<https://assignbuster.com/investigating-the-factor-affecting-osmosis-in-potatos/>

Chemicals

6×3 test tubes

Potato

3 test tube rack

Sugar solution

Measuring cylinder

Distilled Water

Pipette

Electronic Balance

Knife, Potato borer and Ruler

Stop watch

Preparations:

1. Prepare 6 different sugar solutions of different concentration. This is because different concentration of the distilled water and will affect the rate of osmosis. The following table shows the amount of distilled water and sucrose solution to be added to prepare various concentrations of sucrose solutions.

Concentration of Sugar Solution (%)

Volume of sugar solution (cm<sup>3</sup>)

Volume of distilled water (cm<sup>3</sup>)

0

0

100

2

2

100

5

5

100

10

10

100

15

15

100

20

20

100

Thus, 6 different solutions are prepared and experimented to yield more accurate and reliable results. The length of potato will be the same that is each potato strip will be of 2 cm long and the size of it will always be at whatever potato borer used, so that it doesn't disturb the result and only the concentration is affecting the result.

Investigation Method:

Cut out 6 pieces of potato with the help of potato borer.

Put test tubes onto a test tube rack.

Pour out all 6 sugar solutions prepared in each test tube with the help of a pipette.

Weigh the mass of potatoes on an electronic balance before putting them into the test tubes.

Put them in different solutions at the same time and start the stop watch; time it up to 10 minutes.

Pour out the mixtures out of the test tubes immediately after 10 minutes and measure their individual mass after osmosis. Note down you results onto the table.

Repeat the steps 1-6 for two more times to yield more data which could give us accurate and precise results.

Data Collection and Processing:

Concentration of sugar solution (%)

Weight of potato BEFORE (g) +0. 01

Weight of potato

Weight Change (g)

% change in weight

+0. 77 %

Mean % Change

+0. 77 %

AFTER (g) +0. 01

0

1. 30

1. 39

0. 09

6. 92

5. 75



1. 11

1. 17

0. 06

5. 41

1. 22

1. 28

0. 06

4. 92

2

1. 17

1. 24

0. 07

5. 98

5. 51

1. 23

1. 3

0. 07

5. 69

<https://assignbuster.com/investigating-the-factor-affecting-osmosis-in-potatos/>

1. 03

1. 08

0. 05

4. 85

5

1. 21

1. 25

0. 04

3. 31

3. 89

1. 05

1. 12

0. 07

6. 67

1. 18

1. 2

0. 02

1. 69

10

1. 28

1. 21

-0. 07

-5. 47

-0. 56

1. 31

1. 34

0. 03

2. 29

1. 33

1. 35

0. 02

1. 50

15

1. 39

1. 37

<https://assignbuster.com/investigating-the-factor-affecting-osmosis-in-potatos/>

-0.02

-1.44

0.32

1.27

1.29

0.02

1.57

1.21

1.22

0.01

0.83

20

1.33

1.29

-0.04

-3.01

-0.15

1. 19

1. 21

0. 02

1. 68

1. 16

1. 17

0. 01

0. 86

Change in mass of the potato before and after the reaction is calculated by subtracting the mass of the potato before by mass of the potato after, so in the first trial of 0% sugar solution change in mass is as follows:

Change in mass= Mass of potato before - mass of potato after

$$= 1.39 - 1.30 = 0.09 \text{ g.}$$

% change in weight is calculated by multiplying the ratio of difference to the mass of potato before into 100. This would give us the %change in weight.

For example,

% change in weight= (Difference in mass/ Initial mass)\* 100

$$= (0.09/1.30)*100 = 6.92\%$$

The mean % change is calculated by adding the sum of all the trials and dividing the answer by 3. For instance in 0% sugar solution the mean% change is calculated as given below:

Mean % change = Trial 1 + Trial 2 + Trial 3

3

= (6.92 + 5.41 + 4.92) / 3 = 5.75%

Graph 1 - Graphing Analysis

Graph 2 - Change in mass

Conclusion and Evaluation:

Graph 1 above shows on the whole that as the concentration of sugar solution increases, the percentage change in mass decreases (i. e. from 5.51 at 2% and concentration to 3.89 at 5% concentration). This is because of the fact that as the concentration of sugar solution increases the amount of water present in the solution or the concentration of water would be less. Hence, the concentration gradient of the water inside and outside of the potato is less steep. The graph shows a gentle decreasing slope from 0 to 5% sugar solution. This means that the rate of osmosis decrease gently as the concentration of water molecules in and outside are nearer to equilibrium, which is at approximately 4% in this case. After 5% there is a sudden decrease in the slope, this could be due to the reason that there was more movement of water molecules in and out of the potato. However, at 15%, there is an increase in mass (from -0.56 to 0.32) and this proves against the

hypothesis. Thus we can say that the data obtained is anomalous. An error found out in this is the differences of average of mass between each concentration; there is less difference between the results of 0, 2 and 5%. The highest significant difference between the mass of two trials of the same concentration is 0.05 in 5% concentration whereas the highest difference among the 10, 15 and 20% concentration is 0.09 in 10% solution. This can be seen in graph 3 shown below.

### Graph 3- Comparison of significant difference in results

This states that the slope between concentrations 0 to 2% is less steep than concentration 5 to 10% and this concludes that saturating the potato gives a faster rate of osmosis as the concentration or the amount of water molecules in 0, 2 and 5% sugar solution is higher. This suggests that there is an uneven net flow in osmosis. But according to me, this investigation is not reliable on whether the relationship between rate of osmosis and % of sugar concentration are proportional.

Graph 2 shows the % mean change in mass of potato strips at different concentrations. It shows that the % change in mass of potato in 0% sugar solution is highest as the sugar solution is absent in the mixture. This is because of the reason that water can easily pass through the semi permeable membrane and also because the water molecules inside the potato were less in number. The graph also shows that the % mean change in mass of potato is negative in case of 10% sugar solution. This could be because of the reason that there are more water molecules inside the potato

and would come out during the reaction making the potato lighter and unsaturated.

From the results and graph one could easily observe a pattern between the concentration of sugar solution and change in mass. As the concentration of sugar solution increases, change in mass of the potato decreases. That is the rate of osmosis decreases with the decrease in concentration of water molecules. However, there is an anomalies data at concentration 15% as the change in mass is not negative but at 0.32; this concludes that the hypothesis was wrong and so it is not in favour of osmosis theory. In order to improve on this I will have to investigate the change in mass results in all three experiments for concentration at 15%, it should come out to be in negative as the mass of potato should decrease according to osmosis theory. In trial 2 and 3 for 15% sugar solution the change in mass is 1.57 and 0.83 instead of been negative and also there is no calculation mistake. This proves that the there has been error in preparing the 15% sugar solutions.

#### Improvements:

The experiment should be performed more times to collect a good yield of data which could lead us giving an accurate and reliable result. This would also decrease the anomalous data when drawing a graph. The volumes of the solution should be accurate and equal before pouring it into a mixture, or else the concentration of a specific concentration would be altered. The start and end time for osmosis should be taken care off so that osmosis does not take place for different duration for every trial. Weight the potatoes all



together at the same time on individual electronic balance, so that osmosis does not take place to one potato while another potato is being weighed.