

# Osmosis potential in potatoes biology essay



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The purpose of this investigation is to examine the effect of varying the concentration of a sugar solution (sucrose) on the amount of osmotic activity between a potato piece and the solution.

## **Introduction**

Osmosis is a special type of diffusion which involves the movement of water molecules through a partially permeable membrane. Osmosis occurs when water moves from an area of a higher concentration (distilled water) to an area of a lower concentration (sucrose solution). In turn this could be defined as water moving from a weak to a strong solution i. e. the more concentrated sucrose solution.

## **Figure 1 – Osmosis**

**Across the partially permeable membrane a concentration gradient exists. Water molecules are able to move in any direction through the partially permeable membrane. On the right side of the membrane there is a higher concentration of water therefore there will be an overall movement of water to the left.**

**The water molecules pass through the partially permeable membrane until each side has the same concentration level.**

## **Osmosis**

### **Osmosis in plants cells**

In plants cells water moves in and out of them depending on the concentration of the solution surrounding the cells. As plant cells have fully permeable cell walls this allows anything dissolved to pass through. The cell wall prevents too much water entering and in turn bursting due to osmotic

pressure. When water moves into a plant cell the vacuole within increases in size and pushes the cell membrane against the cell wall. As a result, the force of the membrane pushing against the cell wall makes the cell wall turgid. (In effect the osmotic pressure is responsible for keeping herbaceous (non-woody) plants upright). Plant cells which do not receive enough water results in wilting occurring therefore make the plant flaccid. During osmosis if a plant loses too much water it results in plasmolysis occurring.

## **Figure 2 – Plant cells under different environments**

If a plant cell was surrounded by a concentrated solution, with a lower water concentration than the cell this would result in the cell losing water by osmosis. This would be defined as hypertonic.

If a plant cell was surrounded by a solution with the same concentration as the cell there would be no overall movement of water across the cell membrane. This would be defined as being isotonic.

If a plant cell was surrounded by a dilute solution, which would have a higher concentration of water than the cell then the cell would gain water from osmosis. This would be defined as being hypotonic.

## **Hypothesis**

As osmosis is defined as the movement of water molecules across a partially permeable membrane from an area of high water concentration to an area of low water concentration, I predict that as the water concentration decreases in the potato pieces the overall mass and length will decrease too. (As the sucrose solution concentration is increased the more obvious the change in mass and length will be in the potato piece). I also predict that by the end of <https://assignbuster.com/osmosis-potential-in-potatoes-biology-essay/>

the experiment the potato piece in the distilled water (0M) will weigh the most as in osmosis the water from outside the cells will enter the vacuole to dilute it as the cells have a stronger solution in them. Therefore the cells will become full of water and as a result will become turgid.

During the experiment, the small holes within the membrane of the potato piece will allow the water molecules to pass through in and out of solution and the potato piece. This depends on the concentration of the solution.

In the 0 molar - distilled water solution, the water will enter the potato piece because it is of a higher water concentration than the liquid inside the cell of the potato piece. As a result the potato should increase in weight and length. This may also result in the potato piece becoming turgid as the solution surrounding the potato piece is of a weaker concentration.

In the 0.2 molar concentrated solution, I believe there will be a smaller amount of change in terms of the potato pieces' weight. This is because the concentration of the solution and the cell of the potato piece are very similar. I think there will be a small increase in weight of the potato piece.

In the 0.4 molar concentrated solution, I predict that the potato piece will decrease in weight due to the rise in concentration of the sucrose solution. Although I do believe the result will only decrease by a small amount as the concentration of the solution and the cell of the potato piece are still quite close.

In the 0.6 molar concentrated solution, I believe there will be an obvious decrease in the weight of the potato piece. This is due to there being a higher concentration within the potato cell than of the sucrose solution.

In the 0.8 molar concentrated solution, I believe there will be similar result to that of the 0.6 molar but there will be a more noticeable weight loss.

In the 1 molar concentrated sucrose solution, I think there will be the most visible change in weight loss of the potato piece compared to the previous 0.8, 0.6, 0.4, 0.2 and 0 molar solutions. This is because the solution surrounding the potato piece is of a much higher concentration than within the potato cell, which results in more water entering the cell sap of the potato piece.

There are also the proposed variables involved that will allow me to plan and explain the experiment carefully, they are outlined below:

**The Independent variable:** The independent variable is what I intend to change in the experiment, which in this case will be the concentration of each solution, as stated previously from 0 molar to 1 molar. The reason for changing the concentration is to see the effect it has on the potato piece when placed in a sucrose solution of different molarities.

**Dependent Variable:** The dependent variable is what I will be measuring during the osmosis experiment, which will be the change in mass and length of each potato piece. I will be recording the mass before and after the experiment using scales, and I will record the length before and after the experiment using a ruler.

Controlled Variables: When carrying out the experiment I intend to make the test fair by controlling the variables. I will be measuring each potato piece with a ruler to ensure each is of an equal length (2cm). I will use the same amount of solution in which each potato piece will be placed into (10ml). I will also be using the same type of potato during the experiment to avoid any anomalous results as a different potato may affect the rate of osmosis. Finally I be conducting the experiment at room temperature.

## **Preliminary results**

The preliminary test was conducted using six equal lengths of potato pieces and placing each in a varying sucrose solution from a high concentration to a low concentration (distilled water). Each potato piece was measured in length and mass before the test was conducted in order to record the end results.

During my first preliminary test I made the mistake of not measuring the mass and only the length of the potato piece. From this I was able to learn how to carry out the test properly. Below is the result of the second preliminary test:

Solution - Molar

Weight Before (g)

Weight After (g)

Change in weight (g)

Length Before (cm)

Length After (cm)

Change (cm)

**A – 1.0**

0.44

0.39

**– 0.05**

1

1

---

**B – 0.8**

0.45

0.41

**– 0.04**

1

1

---

**C – 0.6**

0.45

0.42

**- 0.03**

1

1

---

**D - 0.4**

0.44

0.43

**- 0.01**

1

1

---

**E - 0.2**

0.43

0.47

**0.04**

1

1

---

**F - 0**

0.44



0.50

**0.06**

1

1

---

From the table above I can conclude that as the sucrose solution concentration was increased the overall weight loss had increased too. In turn the more water concentrated the solution, the more increase in weight. There were no visible changes in length as a result of the increased sucrose concentration.

As a result of my preliminary test I will be changing the length of the potato pieces to 2cm instead of 1 cm as this will give me a better range of results in order to draw up conclusions.

## **Apparatus**

Below is the list of apparatus used to conduct the experiment:

Safety goggles

Test tube rack

1 Cork borer

6 test tubes

Measuring cylinder

Cutting tile

Ruler

Timer

Scales

Sucrose solutions

Distilled water

Potato

## **Fair Test**

In order to make my experiment a fair test I had to ensure that the same method was used through each of the three experiments. During the experiment I had to change one key variable which was to vary the concentration of the sucrose solution. This was to allow a varied range of results in order to draw up a conclusion on the experiment. When carrying out the experiment I made sure to stick to the following variables:

During the experiment I worked at room temperature

I used the same type of potato throughout the experiment.

I measured exactly 10ml of solution for each test tube to ensure the same volume of solution was used.

The potato piece was cut to 2cm using a ruler in order to keep the lengths of the potato pieces the same.

The mass of the potato piece was a dependant variable so I measured the weight of each potato piece using scales before conducting the experiment.

The experiment was timed using a timer for 30 minutes to ensure complete and accurate results.

The mass of each potato piece was measured after the experiment to see if osmosis had taken place.

The length of each potato piece was measured after the experiment to see if osmosis had taken place.

## **Method**

Gather the apparatus needed for the investigation.

Using a cork borer measure out six equal pieces of potato.

Using a ruler cut each piece of potato to a length of 2cm.

Fill five test tubes with 10ml of five varying strengths of sucrose solution.

Fill the sixth test tube with 10ml of distilled water.

Place the six test tubes into a test tube rack.

Label each test tube from A to F, A being the highest concentration to F being distilled water. This is to distinguish each varying strength of the solution in order to have accurate results.

Using scales weigh each piece of potato and record the weight.

Place one potato piece into each of the test tubes.

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10. Start the timer and time for 30 minutes.
11. After 30 minutes take each potato piece out of the rest of the test tubes.
12. Using the scales, weigh each potato piece and record the new weight.
13. Record the results in a results table.
14. To ensure accuracy repeat the experiment twice, this will give a varied table of results.
15. From the results plot a graph.

## **Diagram**

## **Solution**

## **Test tube**

Potato chip

1 Molar

**Distilled Water 0. 2 Molar 0. 4 Molar 0. 6 Molar 0. 8 Molar**  
(0 Molar)

## **Observations**

During the experiment I noticed that the potato pieces of which were placed in the most concentrated sugar solution generally floated to the top of the test tube.

## **Results Table**

### **Solution**

**Weight Before (g)**

**Weight After (g)**

**Change in Weight (g)**

**Average weight (g)**

**Length Before (cm)**

**Length After (cm)**

**Change in Length (cm)**

**Average length (cm)**

1

2

3

1

2

3

1

2

3

1

2

3

1

2

3

1

2

3

A - 1.0

0.56

0.61

0.59

0.51

0.54

0.54

- 0.05

- 0.07

- 0.05

**- 0.06**

2

2

2

1.9

1.9

1.9

- 0.01

- 0.01

- 0.01

**0.01**

B - 0.8

0.60

0.56

0.59

0.52

0.56

0.55

- 0.08

---

- 0.04

- **0.04**

2

2

2

1.9

1.9

1.8

- 0.01

- 0.01

- 0.02



**0.013**

C - 0.6

0.57

0.53

0.60

0.55

0.51

0.55

- 0.02

- 0.02

- 0.05

**- 0.03**

2

2

2

1.9

1.8

1.9

- 0.01

- 0.02

- 0.01

**0.013**

D - 0.4

**0.58**

0.62

0.59

**0.55**

0.62

0.57

**- 0.03**

---

- 0.02

**- 0.02**

**2**

2

2

**1.9**

2.0

2. 0

**- 0. 01**

\_\_\_\_\_

\_\_\_\_\_

**0. 003**

E - 0. 2

**0. 61**

0. 59

0. 63

**0. 63**

0. 61

0. 64

**+ 0. 02**

+ 0. 02

+ 0. 01

**0. 02**

**2**

2

2

**2.0**

2.0

2.0

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

**0**

F - 0

**0.56**

0.60

0.53

**0.60**

0.63

0.58

**+ 0.03**

+ 0.03

+ 0.05

**0.04**

**2**

2

2

**2.0**

2.0

1.9

---

---

- 0.01

**0.003**

## **Graph**

### **Conclusion**

From my results table I can see the effect of osmotic activity within the potato pieces by water molecules moving through a partially permeable membrane which exists across the concentration gradient. The molecules move into an area of lower concentration which in this case is the sucrose solution because osmosis only takes place from an area of high water concentration to an area of low water concentration. The more osmotic activity which took place resulted in the potato pieces decreasing in length and weight. From the graph you can see that the pieces of potato which were placed in a 0.2 molar concentration or less increased in weight and length and those placed in a 0.4 molar concentration or higher decreased in weight and length.

As stated in my hypothesis I predicted that there would be a decrease in weight and length. As the potato cell was surrounded by a more

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concentrated solution this resulted in there being a lower water concentration within the potato cell which meant osmosis took place making it hypertonic. As predicted my results were correct the potato pieces which were more water concentrated weighed more compared to the potato pieces which were in a more sucrose concentrated solution.

## **Evaluation**

Overall I feel that the experiment went well as there no major anomalies during the experiment. I think the method that was used to conduct the experiment was very suitable as it wasn't too time consuming and it was easy to carry out. It was also a good method to use because it gave me reliable and accurate results in order to draw up a conclusion. The preliminary test also allowed me to plan out how I would carry out the real experiment and if I needed to make any changes such as the length of the potato piece which was increased to 2cm instead of 1cm.

However if I were to carry out the experiment again there would be a few things that I would change. When carrying out the experiment I used a range of 0, 0. 2, 0. 4, 0. 6, 0. 8 and 1 molar solution to see the effect of osmosis in the potato pieces. In the future I would like to have more varied range of the concentration of the solution in order to produce a more varied range of results i. e. 0, 0. 1, 0. 2, 0. 3... There was an anomalous result as shown on the results graph as the 0. 4 molar solution was further away from the line of best fit. This may have been due to the fact that the potato piece was dried more compared to each other potato piece therefore this would result in a more noticeable decrease in mass i. e. it went from a 0. 02 increase in mass in the 0. 2 molar to a 0. 02 decrease in mass in the 0. 4 molar. As a result in <https://assignbuster.com/osmosis-potential-in-potatoes-biology-essay/>

carrying out any future experiments I would make sure each potato piece is dried under the same amount of time and method. I would also leave the potato pieces in the solution for a longer length of time as they were only in the test tubes for 30 minutes. I would consider changing the time to 60 minutes as I feel there would be a more noticeable range of results therefore better conclusions could be drawn up. There would also be a great advantage to repeating the test 5 times instead of 3 as this would vary the results even further.

- In the number 1 visking tube there is a much higher concentrated solution than the solution surrounding the visking tube inside the beaker which is distilled water. As a result this means the amount of liquid inside the visking tube will rise through osmosis.

- In the number 2 visking tube there is a much lower concentrated solution than the solution surrounding the visking tube inside the beaker which is a sucrose solution. As a result the level of liquid inside the beaker will rise through osmosis.

In the future I would also consider doing a different type of experiment such as visking tubing. Visking tubing is a partially permeable membrane which is made from regenerated cellulose which allows small molecules like water to pass through but doesn't allow large molecules to pass through such as glucose because they are too big to diffuse out into the water. When a visking tube is placed into a beaker, which is filled with distilled water, the water molecules will pass from the beaker into the visking tube which will dilute the sucrose solution. The visking tube is attached to a glass tube; this

allows the rise of water to be seen from the glass tube when water is moving from the beaker into the visking tube.