January 12th, 2016

1.

Contact Information

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The Osmotic Pressure in Fragaria:

Question:
How does the concentration of sugar in water impact the mass of strawberry pieces due to osmosis?

Purpose:
The purpose of this project is to determine how varying levels of sugar concentration in an aqueous solution affect the osmotic pressure and resulting mass of strawberry slices.

How I Came Up with This Project:
I noticed that strawberries always get mushy and watery when I add sugar to them. I wanted to use the scientific method to find out if this was due to osmotic pressure and how different concentrations of sugar would change the fruit's weight and texture.

Why I Chose this Project:
I chose this project because I was curious about why strawberries become soft and syrupy when sugar is added. I discovered that this is a scientific process called osmotic dehydration. I wanted to investigate the relationship between sugar concentration and mass loss to see how osmotic pressure can be used as a naturally energy-efficient way to preserve fruit and reduce food waste.

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The Meaning

What the Osmotic Pressure in Fragaria is:

Osmotic pressure is the pressure required to stop the movement of water across a semi-permeable membrane. In my experiment, the strawberry cells membranes act as this barrier. Fresh, ripe strawberries have an internal osmotic potential of approximately −0.6 MPa to −2.0 MPa. This, negative pressure exists because strawberries are packed with solutes like glucose, fructose, and sucrose.

What Supplies I Need:

- 3 clear cups
- Water
- Sugar
- Measuring tablespoons
- 3 fresh strawberries
- Knife
- Cutting board
- Digital or balance scale
- Paper towels
- Spoon or stir stick
- Timer or clock
- Notebook and pencil for recording

Procedure:

1. Prepare the Solutions:

Group A: Fill one cup with ordinary water (2 tbs)

Group B: Fill a second cup with water and stir in a small amount of sugar

Group C: Fill a third cup with water and stir in an abundance of sugar until it is a thick syrup (6 tbs.)

2. Prepare the Strawberries

- Slice a strawberry into several pieces
- From the slices, select three sets of strawberry pieces that are near the same size and shape

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Glossary

- Weigh each set of pieces on a scale and record their exact starting weight

3. Conduct the Experiment:

- Place the first set of strawberries into the plain water (Group A)
- Place the second set of strawberries into the slightly sugary water (Group B)
- Place the third batch into the cup of very sugary water (Group C)
- Set a timer for two hours

4. Make your Observations:

- After the time is up, carefully remove the pieces from each cup
- Gently pat them dry with a paper towel to remove any extra solution
- Weigh each batch again and record their final weight
- Note any physical changes observed, if they are softer or firmer.

Glossary:

Osmosis: The net movement of water molecules through a semi-permable membrane from a region of high water potential to a region of low water potential.

Osmotic Pressure: The minimum pressure which needs to be applied to a solution to prevent the inward flow of its pure solvent.

Fragaria: The scientific genus name for a strawberry.

Semi-permable membrane: A biological barrier that allows small molecules like water to pass through but blocks larger molecules like sugar.

Solute: The substance that is dissolved in a liquid like sugar.

Solvent: The liquid that does the dissolving like water.

Concentration Gradient: The difference in the concentration of sugar molecules between the inside of the strawberry.

Hypotonic: A solution with lower concentration of solutes.

Hypertonic: A solution with higher concentration of solutes.

Isotonic: A solution where the solute concentration is equal to the strawberry cells.

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Hypothesis

Hypothesis:

My hypothesis for this investigation is that the amount of water movement in the strawberry tissue will be entirely dependent on the surrounding liquid's sugar concentration, specifically how the osmotic concentration differs between the inside and outside of the cells. I believe that the results will vary significantly based on whether the solution is hypotonic, isotonic, or hypertonic.

I predict that the isotonic strawberries will have a minimal change in mass, ideally 0% change. They should maintain their original apperance and firmness, serving as my control group.

My prediction for the hypertonic strawberries is that they will lose most of the mass, likely between -15% and 30% of their original weight, because the water is being pulled out of the cells.

For my hypotonic solution, I believe that these strawberries will gain a noticeable amount of mass, likely between +10% and +20% of their original weight, because water will rush into the cells. They should feel very firm and plump.

This was my prediction and hypothesis on my experiment.

Variables:

What I Changed (Independent Variable)

- The amount of sugar in the water: I used plain water (hypotonic), medium sugared water (isotonic), and thick syrup (hypertonic). This single change is what I believe will cause the different results.

What I Measured (Dependent Variable)

- The change in weight of the strawberry pieces: I recorded the mass gained or lost to quantify the effect of osmosis. I also noted how firm or soft they became.

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Research

What I Kept the Same (Controlled Variable)

- Same amount of time soaking: Every group soaked for exactly two hours. This ensures time is not a factor in how much water moves.
- Same temperature: I kept all cups at the same room temperature. Temperature can affect how fast water moves, so keeping it constant is critical.
- Same initial mass and size of the strawberry pieces: All batches started with the same amount of mass and size. This makes sure I am comparing results fairly using the percentage change solution.
- Same type of strawberry: All samples came from the same kind of strawberry. Using a consistent source ensures the cells all begin with the same biological state.

Research:

Osmosis is the movement of water through a cell membrane from where there is more water to where there is less water. Plant cells rely on osmosis to stay firm and full of water, which helps the plant maintain its shape. When cells gain water, they swell and become firm, but when they lose water, they shrink and may become soft or wilted. If the amount of water inside the cell and outside the cell is equal, the cell stays about the same size.

Different solutions can cause water to move in or out of plant cells in different ways. A hypotonic solution, like plain water, has less dissolved material than the cells, so water moves into the cells and makes them swell. A hypertonic solution, like a thick syrup mixture, has more dissolved material than the cells, so water moves out and the cells shrink. An isotonic solution, which has a similar amount of dissolved material as the cells, causes no change in the water movement, so the cells stay the same.

Strawberries are good for observing these changes because their tissues clearly show the effects of water movement. By cutting strawberries into pieces and placing them in different solutions, we can measure how much water is gained or

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Notes & Ideas

lost over time. We can also observe whether the fruit becomes firmer or softer, which gives visible evidence of osmosis in plant cells.

This experiment will test three different sets of strawberry pieces in plain water, slightly sugary water, and very sugary water for exactly two hours. By weighing the strawberries before and after soaking, we can see how water moves into or out of the fruit cells. Observing these changes helps us understand how osmosis works in plants and why water balance is important for plant health and fruit quality.

Daily Notes & Ideas:

November 16th: I figured my project topic: the Osmotic Pressure in Fragaria

January 19th: I have decided to increase my trials from 1 to 3 per group. This will ensure my data is more reliable and meets C.Y.S.F. judging standards.

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Time Table

Time Table:

November-December 2025: Record why I chose my project and what it is
December 2025: Look up all the websites used for the project as well as books
Early January 2026: Start the logbook with all information
January 2026: Make sure I have all my materials and scales as well as my procedure and variables
February 27th 2026: Conduct the experiment and write when it was conducted
February 27th-28th, 2026: Write and record your results and analysis
February 6th, 2026: Basic Information and Ethics and Due Date (2A) is due
February 28th, 2026: Record your calculations for a percentage and the formula
March 1st-2nd, 2026: Make sure all forms are finished as well as logbook and slideshow filed into the website/application. Also, finish your trifold and graphs
March 1st, 2026: Start and finish cue cards
February-April: Practice and rehearse cue cards and trifold
February: Touch-ups or finalizes on trifold (not the due date, only recommended)
March 4th, 2026: Project completion and log the date
March 5th-April 8th, 2026: Final touch-ups and practice sessions with cue cards
April 9-11th, 2026: Fair days

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Citations

Citations:

pg. 1 - My Purpose - https://bio.libretexts.org/Courses/Cuesta_College/Fundamentals_of_Biology_Lab_Manual_(Marks_and_Hochman_Adler)/04%3A_Cells_-_Kitchen_Cells_and_Membranes/4.06%3A_Osmosis_and_Tonicity

pg. 2 - What Is The Osmotic Pressure in Eragrostis? - https://www.frontiersin.org/journals/plant-science/articles/10.3389/fpls.2020.01035/full

pg. 3 - Glossary - https://www.britannica.com/science/osmosis

pg. 4 - Variables - https://www.sciencebuddies.org/science-fair-projects/science-fair/variables

pg. 5 - Research - https://www.sciencebuddies.org - NGK & NASA Science

pg. 10 - Extensions - www.scienceofcooking.com

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Materials

Materials:

- 3 clear cups
- Water
- Sugar
- Measuring tablespoons
- 3 fresh strawberries
- Knife
- Cutting board
- Digital scale
- Paper towels
- Stir stick / spoon
- Timer
- Notebook and pencil for recording

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Extensions

On Macerating Fruit for Dessert:

My experiment directly relates to the culinary process of maceration. When sugar is sprinkled on strawberries for a dessert, it creates a hypertonic environment on the outside of the fruit. This causes osmosis to pull out water of the strawberry cells to dissolve the sugar, which is why the fruit becomes soft and creates its own sweet syrup.

On Making Jam & Food Preservation:

The high sugar concentration I am using in Group C is similar to the process of making jam. In food preservation, high levels of sugar create intense osmotic pressure that draws water out of the fruit. This also protects the food from spoiling because the sugar pulls water out of any bacteria or mold cells, preventing them from growing.

On Food Texture & Industry:

Understanding osmotic pressure in fragrance is important for the food industry to control texture. If a food scientist wants to keep fruit firm in a container, they must balance the sugar levels in the liquid to prevent the fruit from losing water or bursting.

March 1st 11
2026

Application

Summarized Application:

Food & Grocery:

In the culinary industry, chefs use the process of osmotic dehydration to create jams and candied fruits, they pull water out of the fruit to change its texture and prevent it from spoiling. This is also why grocery stores spray their produce with water, so it can stay crisp and fresh.

Agriculture:

In agriculture, farmers need to be careful about the salt levels in the soil. If the soil is too salty, the water will move out of the plant roots and back into the soil, causing the plants to wilt.
Chefs use maceration to create strawberry syrup without cooking it for desserts like shortcake or pancakes.

Medicine:

When a patient's kidneys don't function, there is a same pulling force through hemodialysis. It takes out the patients blood.

March 6th 2006

Analysis

In Group A the After bar is taller than the Before bar, showing a significant average mass gain of +3.62%. because the plain water was hypotonic and soaked into the cells to create pressure.

Group B also gained +1.43% in mass, which tells me the sugar concentration in the water was still lower than the natural sugars.

However, Group C shows the most change in the opposite direction. The After bar is shorter than the Before bar, resulting in a negative percentage change at -9.64%. This proves that the 6 tablespoons of sugar created a strong hypertonic environment that acted like a magnet.

Sources of Error:

It is important to reflect on sources of error that might have influenced the final numbers. Firstly, the surface moisture was a major factor. When I took out the strawberries from the solutions, they were soaking wet. If I didn't pat them dry, it would have introduced a new weight measure. Another error was the biological difference between the strawberries. When cut to similar sizes, each slice has a unique number of cells and varying levels of natural sugars which can affect how quickly osmosis occurs. Though I aimed for each set of strawberry pieces to weigh the exact same, there was still a gap in between. Adding on, the slight tension on the scale was also difficult to overcome. If the scale was not perfectly still or a slight breeze in the room, it would change the weight by 0.01g or more. Finally, a very important source of error was mixing the solutions. If the sugar in Group B and C was not dissolved properly or stirred the exact amount of times, the concentration of the sugar might have stronger at the bottom or top of the cup.

These were the main sources of error I overcame during this experiment.

March 1st, 13
2026

Conclusion

In conclusion, my experiment shows that the amount of sugar in a solution definitely changes how water moves in and out of a strawberry through osmosis. My results showed that Group A gained the most mass at +3.03g%, which confirms that in a hypotonic environment, water rushes into the cells and makes the fruit feel firm and plump. This happens because the extra water creates turgor pressure which acts like a balloon inflating inside the strawberry's cells walls, making the slices feel crisp and sturdy when touched.

Group B also gained a small amount of mass (+1.42%) and felt slightly firmer than before. This tells me that the natural sugar concentration inside the strawberry was still slightly higher than the two tablespoons of sugar in the water, so the water continued to move into the fruit.

However, Group C was the only group that showed a clear loss in mass, with an average drop of -2.84%. This proves that a hypertonic solution act like a magnet that extracts water from the cells. As the cells lost their internal liquid the strawberries became noticeably softer and lighter. While my data mostly supported my hypotheses, I discovered that the isotonic became near the same balance where the strawberry doesn't gain or lose any weight.

Overall, this project successfully shows how solute concentrations are a vital part in food science, explaining why our fruit stays fresh and how industries use sugar to preserve the desserts we enjoy everyday!

March 14th 2006

Tri-Fold

I wanted to give full credits to where I bought all my items on my tri-fold! Thank you to everyone, every stores, and every thing!

Red sparkly letters:
Micheals

Print Outs:
Staples

Red Border paper:
Micheals

Strawberry stickers:
Amazon

Small red sparkly letters:
Micheals

Tri-fold:
Micheals

Farhat K

I would love to appreciate and thank my grandmother and mother for helping me with my tri-fold! They both helped a lot!
Maryem K

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8006

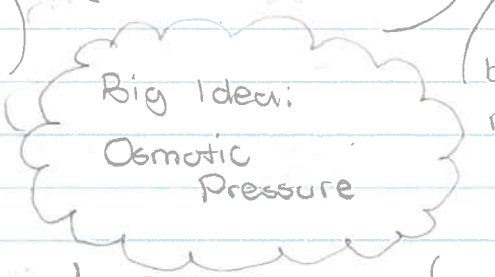
Brainstorming

I drew a cloud for my ideas before I picked the Osmotic Pressure in Fragaria:

October:

I chose 24 hours because it is not too long but not too short.

10 minutes, 1 hour, 24 hours, 24 hours, 48 hours



Raspberries, blueberries, strawberries, mangoes

I chose strawberries because it has a very reactive skin shield.

Juices, water, soda, honey, sugar, salt

I chose sugar because it's a common solute used in foods.

Measuring mass, colour, height, direction

I chose mass because it's the most accurate way to know if osmosis is occurring.