

The effect on osmosis on the egg shell essay sample



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Osmosis is the transport of water molecules from an area of their high concentration (hypertonic solution) to an area of their low concentration (hypotonic solution) through a semi-permeable membrane¹ such as cell membrane. This tendency, when water molecules move from one region to another is called the water potential. Osmosis is also called the passive movement so it does not require energy as direction of transport is down the concentration gradient. What is important, the movement of water molecules occurs until the state of equilibrium, so-called isotonic environment, is reached.

Thanks to process of osmosis, an egg will shrink or enlarge depending on the saturation of the solution of the surrounding. The process of osmosis will cause an egg to shrink after its submergence in solution with lower concentration of water and higher concentration of solute outside (hypertonic), respectively, an egg will enlarge after its displacement in solution with greater concentration of water and lower concentration of solute outside (hypotonic). In this experiment, de-shelled quail's egg will be submerged in three different liquids: distilled water, 5% salt (NaCl) solution and 10% salt solution, thus the aim of the investigation is to observe process of osmosis and changes in eggs' masses connected with it, in different solutions. As it was already mentioned, eggs' shells were dissolved (in hydrochloric acid) in order to attain more reliable results.

HYPOTHESES

* Solvent will diffuse inside the egg as during osmosis, water molecules move from hypotonic solution to hypertonic solution

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* The greatest mass change will occur in set where an egg is immersed in distilled water as there is the greatest difference in substances dissolved in water

RESEARCH QUESTION

How does the mass of an egg will change after submergence in distilled water and solutions that differ with salt concentration?

VARIABLES

Apparatus

Units

Range

INDEPENDENT VARIABLE

1. Different concentration of salt solution

[%]

0-10 %

DEPENDENT VARIABLE

1. Mass change of eggs*

Electronic balance

[g] [0. 01 g]

*thanks to this, indirectly mass change In eggs will be measured

Possible effect(s) on result

UNCONTROLLED VARIABLE

1. Size of air cell inside the egg

It affects degree of egg's immersion and may affect process of osmosis as it reduces contact surface between surrounding and content of egg (which is separated by semi-permeable membrane

2. Surface area of cell membrane

Smaller surface area of cell membrane may decrease surface of site of osmosis

Method of control

Possible effect(s) on results

CONTROLLED VARIABLES

1. Temperature of surrounding

Thermometer [C, 1C]

Temperature may affect structure of egg's proteins and solubility of salt in water. It would be the best if the experiment was carried in room temperature (23C)

2. Type of specimen (quail's egg)

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It may affect content of e. g. nutrients, water in egg

3. Origin of specimen

4. Condition (i. e. freshness) of eggs

5. Size (classification) of an egg

Different size, thus different mass leads to unreliable results as e. g. there is greater surface of osmosis process

6. Time of experiment

Watch [s, 1s]

It should be equal for all sets. Longer time of the experiment, more noticeable change in mass of eggs

7. Time of immersion in HCl

Watch [s, s]

It influences egg cell dissolution

8. Way in which egg are hold in the solution during experiment (they have to be completely immersed)

Observation (the tool used was a test tube)

Egg has to be submerged completely, as it affects surface of osmosis process

MATERIALS AND EQUIPMENT

- > Eighteen quail's eggs (three per each set)

- > 1000 ml of distilled water (150 ml per each group)

- > 45 g of table salt (NaCl; 7.5 g per each group)

- > 550 ml of hydrochloric acid (1 mol)=> WARNING! In order to avoid burn caused by the acid, wear rubber gloves and apron

- > Measuring cylinder [100 ml] [1ml]

- > Two large beakers [300 ml]

- > Three smaller beakers [75 ml]

- > Electronic balance " Radwag WLC 2/A2"; max. mass - 2 kg [0.01g]

- > Paper towels

- > Three test tubes (if eggs are not completely immersed)

- > Stirring rod

- > Thermometer

SAFETY CONSIDERATIONS

Be careful when using hydrochloric acid, for your safety wear rubber gloves and apron. Do not use broken glass beakers.

F Figure 1. Materials

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F Figure 2. Materials

PROCEDURE (per group) Figure 3. Electronic balance

Note that eggs should be fresh, of the same type and taken from the same origin as it may influence results. Because the experiment is respectively long if we take into consideration available time at school, each group should carry out the same experiment, so that there would be enough measurement (in this case six). What is more, you have to try to keep the temperature of the room constant.

1. Prepare all equipment given in Materials and Equipment, wear apron and rubber gloves.
2. Put quail's eggs into large beakers [300 ml].
3. Pour concentrated hydrochloric acid (1mole) over eggs so that they were completely immersed. You will observe formation of the bubbles - it will mean that a gas is releasing so a chemical reaction has taken place. Wait until eggs' shell will dissolve (for about hours)
4. When eggs' shell will dissolve, gently take out each of egg, accurately rinse them out, and dry them with paper towels. Now you can take rubber gloves off.
5. Prepare three solutions:
 - a) Set 1(the controlled set)=> into smaller beaker [75 ml] pour 50 ml of distilled water measured with measuring cylinder [1ml]

b) Set 2=> into smaller beaker [75 ml] pour 50 ml of 5% salt solution (2.5 grams of salt measured with electronic balance [0.01g], dissolve completely by stirring in 50 ml of distilled water measured with measuring cylinder [1ml])

c) Set 2=> into smaller beaker [75 ml] pour 50 ml of 10% salt solution (5 grams of salt measured with electronic balance [0.01g], dissolve completely by stirring in 50 ml of distilled water measured with measuring cylinder [1ml])

d) Label all beakers accordingly to contained solutions

6. Weigh each of dried egg separately using electronic balance [0.01g].

7. Write down the results in table presented below.

BEFORE MEASUREMENT

AFTER 30 MINUTES

AFTER 1 HOUR

? of measurement

8. Put one egg per set gently. Eggs should be immersed completely, if they are not accurately dip them with test tube.

9. After 30 minutes carefully take out an egg, dry it with paper towels, and measure its mass using electronic balance [0.01g]

10. Repeat this action for each of egg. Be careful to not mix up eggs.

11. Results note down.

12. After measurement of all three eggs, put them again into solutions (they still have to be completely immersed)

13. After next 30 minutes carefully take out an egg, dry it with paper towels, and measure its mass using electronic balance [0.01g]

14. This action repeat for each of egg. Be careful to not mix up eggs.

15. Results write down.

16. Process the obtained data accordingly to the formulas and term presented in PROCESSING OF THE DATA

* Measurements recorded by my working partner and me

PROCESSING OF THE DATA

The statistical analysis terms and the formulas that I will use during processing of the data

1. Range - the difference between the largest and the smallest observed values

2. Mode (Dominanta) - identifies category with highest number of raw data entries

3. Median - identifies the middle value for an even number of entries

4. Range - the difference between maximum and minimum value

5. The formula for calculation of standard deviation ()

6. The formula for calculation of change in mass after immersion for particular time

7. The formula for calculation of mean change in mass of eggs

8. The formula for calculating percentage change in mass in overall

Note that in all graphs presented below, set 1 is a set with distilled water, set 2 is a set with 5% salt solution, set 3 is a set with 10% salt solution.

Graph 1. Mean results for all of the measurements with error bars

Graph 2. Mean percentage changes in mass after 30 minutes with trendline and error bars

Graph 3. Mean percentage changes in mass after 1 hour with trendline and error bars

ANALYSIS AND CONCLUSION

According to Table 5 which presents changes in mass [g] and percentages that were calculated from means presented in Tables 3-4 eggs' mass increased in set 1 (with distilled water) and set 2 (with 5% salt solution). It is significant to note that the change mass was shown on means of all six measurements. This method was used because discussing each measurement of each set seemed pointless as sometimes they differed remarkably. These notable dissimilarities are visible on Graphs 1-6 which present results for each of measurements. Actually the greatest differences

occurred for set in which egg was immersed in distilled water. It is also proved by the ranges shown in Tables 2-4.

According to results recorded after second submergence the range equaled to 5.41, and after third immersion, the range in measurements was 5.7. In set 2 and 3 results did not deviate so much. What more can be said about statistical analysis is that there was no mode, median values were not greater either lesser than 11 (what may indicate not great mass change e. g. because time of experiment was too short) and standard deviation exceeded "1" only in the first set, thus results seem to be relevant.

Tables 2-4 present results for each measurement. The differences among the same sets in the same time of measurements occurred probably because of students mistakes e. g. not wiping eggs carefully, not equal time of putting the eggs into the beakers, or because of factors that were uncontrolled e. g. air cell that hampered fully immersion. Although some fluctuations were observed, the general trend (see Graphs 2-3) shows that due to salt concentration of the surrounding increase, the less is change in mass of an egg.

According to Graph 1 and Table 5 illustrating mean results all of the measurements, the mass increase occurred in sets 1 and 2 (hypotonic). In these two sets, the trend was the same, although the percentage of mass change differed significantly. After first immersion, increase in set 1 equaled to 8.03% while in set 2 it was 1.74%. After the second submergence, increase in set 1 equaled to 3.63% while in set 2 it was 1.88%. If the general increase will be taken into account, it seems be more notable: in set

in which egg was immersed in distilled water, the mass increased by 11.95% while in set with 5% solution it increased by 3.65%. In set 3 there was firstly decrease (-1.13%) than increase (+0.88%), which actually did not “compensate” loss of previous submergence, after an hour, the general decrease was -0.26%. These fluctuation can be explained by the fact of attempt to reach state of an equilibrium, i. e. the solutions became isotonic solution. In state of equilibrium, remainders of water potential are very insignificant.

When osmotic pressure is approximately equal on both sides, there is inhibition of osmotic movement of the solvent. But before equilibrium is reached the water molecules move outside of the egg (hypertonic). The process occurring in set 3 can be compared to process of dehydration in humans. People cannot drink salt water in order to hydrate the organism because the water from our cells diffuses outside where is high concentration of solute, i. e. salt, and low water potential. Because of this, the cells start to lose water what results in dehydration. In the same way acts water molecules in the set 3 - they move outside of an egg where is higher concentration of substances dissolved in water and low water potential. Consequently, an egg will become hypotonic to its surrounding and will shrink. There were two sets in which the eggs were immersed in salt solutions.

Because of difference in solutions' salt concentration, the mass changes varied as well. In general, it can be said that when the salt concentration is increased, concentration of water decreases and respectively, when the salt concentration is decreased, concentration of water increases. According to <https://assignbuster.com/the-effect-on-osmosis-on-the-egg-shell-essay-sample/>

such observations which support my hypotheses, it can be said that the greatest observation occurred in set with distilled water because there was the most significant difference in concentration of substances dissolved in water, while set with 10% salt solution, was the closest to reach an equilibrium probably due to approximate concentration of substances dissolved in water. Because of process of osmosis (when water molecules move from an area of higher water concentration to an area of lower water concentration⁵), the decrease in mass of the egg is caused by situation when the water concentration of salt solution in the beaker is less than the water concentration inside the egg. The increase in mass of the egg is caused by the situation when the water concentration of salt solution in the beaker is higher than the water concentration inside the egg.

As similar experiment was carried by the students of biology in the University Of Los Angeles (results presented by Dani Sieng), obtained results seem to be correct.

Summary of all conclusions is illustrated in Figure 4 (see below).

Figure 4. Direction of osmosis and its explanation in all three examined sets

GENERAL CONCLUSION

In set 1 (with distilled water) and set 2 (5% salt solution) the direction of osmosis is the same i. e. water molecules move inside the egg what results in increase of the mass, while in set 3 (10% salt solution), water molecules diffuse outside of an egg, causing decrease in mass. These trends occur accordingly to theory of osmosis which states that water molecules move

from an area of higher water potential to an area of lower water potential. Despite the fact that in set 1 (with distilled water) and set 2 (5% salt solution) the direction of osmosis was the same, the greatest mass change took place in set 1 as there was greater difference in substances dissolved.

EVALUATION

I think that the research question was clearly formulated as the independent and dependent variables were included and the hypotheses were testable. Although hypotheses were right, it should be specified that only higher salt solution (as 10%) changes the direction of osmosis. I think that procedure and methods that were carried out were as good as available equipment, apparatus and time allowed.

Limitations:

- * Time of the experiment was too short, so further changes in mass could not be observed
- * Beakers had different diameters, as the amount of solution was equal, "height" of solution varied, this affected degree of submergence

Weaknesses (note that more significant weaknesses will be indicated with "s")

- * On some eggs, the shell did not completely dissolved, it reduced (but insignificantly) the side, or to some extent rate of osmosis process

- * Some students did not wipe eggs carefully before measurement of eggs' mass (s)
- * Some students did not put eggs (after measurement) at the same time, so the time that was measured after submergence was not equal what affected results (s)
- * The air cells in eggs hindered complete immersion of the eggs (s)
- * Because of air cell, test tubes were used in order to hold the eggs under water, but it was quite dangerous as semi-permeable membrane is very delicate, what is more, because of the region were test tube contacted membrane, the surface of osmosis process was reduced
- * Some students did not even try to immerse the eggs completely (s)
- * While pouring salt solution, measuring cylinders with different accuracy were used because there was not enough time for carrying out the experiment
- * While drawing the graphs, the trendlines were not drawn as it made the image unclear

Advantages

- * In our class, one person prepared salt solutions so there was no probability that someone while preparing solutions for her/his group would make a mistake while measuring water either salt

- * Electronic balance with accuracy 0.01 g was used, it made results more reliable
- * Statistically, enough measurements were carried out
- * Type, origin, condition and size of the eggs were controlled so the results were more reliable
- * Safety precautions were taken while using hydrochloric acid in part of dissolving eggs' shells
- * Based on range, collected data are good quality
- * Egg's shell was dissolved, left semi-permeable membrane was excellent for the experiment as it is flexible and very thin

Suggestions of improvements:

- * The experiment should last longer (e. g. 5 hours) in order to find out how mass of the eggs will change later
- * It would be good if more kinds of solutions (i. e. not only salt but e. g. sucrose) were used
- * It would also be interesting to find out how the change in egg's mass caused by the process of osmosis influences its buoyancy (so eggs cannot be immersed)
- * More salt solutions should be done, so that greater range of results will be attained

- * It would be good to measure change in egg's horizontal and vertical length, not only its mass

- * All beakers should be the same sizes

- * There should be available more apparatus of the same kind and accuracy

- * Beakers with smaller diameter should be used in order to prevent the egg from bringing to the surface but also to not reduce significantly surface of osmosis process as if with using test tubes

- * Although it would be require more work and time, the data should be collected by one person in order to avoid differences in measurements and other obstacles connected with irresponsibility of other students, so there should be more eggs

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