

Which substance best preserves an apple slice?

Aim: The purpose of this investigation is to discover which tested substance is superior in terms of the preserving an apple.

Hypothesis: The substances we believe will preserve the apple slices the best are:

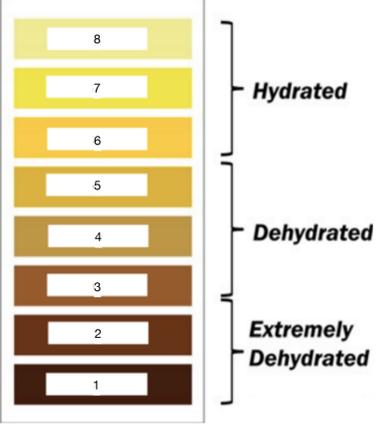
- "Ice" as by freezing the apple sample, will help preserve the apple slice by stopping "nutritional depletion".
- We believe "Coke" will preserve the apple slice the **shortest** amount of time due to its high levels of sugar, which, according to "<http://www.ion.ac.uk/content/well-preserved-how-preservation-techniques-affect-food>" affects preservation negatively.

We also believe that vinegar will NOT preserve the apple slice as it contains a high amount of acid compared to the other substances, which will not preserve the apple, however, does the exact opposite.

- Apparatus:**
- Cups x16
 - Apple x2
 - Measuring Scale
 - Camera
 - Knife
 - Bottle of water x2
 - Ice (50g)
 - Oil
 - Vinegar
 - Coke
 - Freshly Squeezed Lemon Juice
 - Air
 - Salt Water

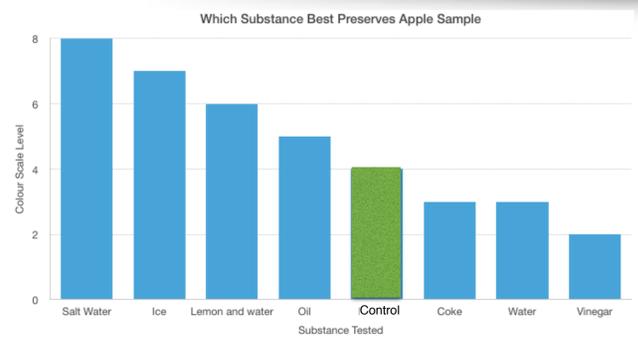


Colour Scale



Risk Assessment

Identify	Assess	Control
Bacterial Infection	If the substance comes in contact with the person (when spilled), it has a chance of infecting the person and could lead to serious illnesses.	Make sure the substances are secured on a hard surface and isolated
Cutting Yourself	This experiment involves using a knife, this is a risk as someone could get injured by cutting themselves.	Make sure the blade of the knife is pointed away from you at all times when cutting the apple. When the knife is not in use store safely. Use an adult to help you.



Colour level >

Median	Range	Mode
4.5	6	3,7

Observations:

As shown by the results, it is shown that **freezing the sample in ice** is superior in terms of preservation of apple as the colour didn't vary much over the 5 day period and the apple sample did not become soggy, however, it was quite stiff compared to the other samples. This showed that freezing the apple sample in **Ice** causes the sample to be strengthened and also preserves the colour. The salt water solution preserved the **colour** of the apple however the apple sample became quite soggy, it however came in second in terms of apple preservation. The lemon juice and water solution tinted the apple sample yellow as the apple sample absorbed some of the solution, there was no browning at all and the sample was quite soft, it came in third in terms of preservation. Water, oil and nothing respectively were average in preserving the apple slices. Meanwhile coke seemed to be a bad decision. Therefore **ice** is the best at preservation out of all the substances tested, followed by Salt Water and then Lemon Juice. Vinegar was demonstrated least superior in the preservation of apples.

Results:

Substance	Coke	Salt Water	Lemon Juice and Water	Vinegar	Oil	Water	Ice	Control
Colour level Scale 1-8 8=apple preserved		3	8	6	2	3	7	7
Softness 1=Hard 2 = Normal 3= Soft		1	3	3	1	2	2	1

These are the averages of each sample for each substance.

How will this experiment help us in future?

This experiment will be helpful in the future for scientific, educational, and commercial purposes. Primarily, this experiment will be very useful in the future to help scientists discover new ways to preserve foods and also instead of wasting fresh food they can test on preserved foods to stop wastage. This could lower the rate of starvation as there is more food to go around. It can also be useful for educational purposes to teach the youth about the natural properties of certain substances and how they react under certain conditions when they come into contact with them. For example: how the acidity in vinegar affects and rots the apple. This experiment can also be used for commercial purposes as the preserved food can be advertised to attract customers. This experiment will certainly be very useful for the future.

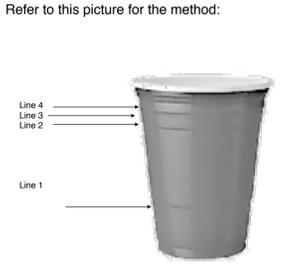
Background Information:

The chart on the left shows that Lemon Juice and Vinegar have a pH level of 2 and coke with a pH level of 3. Sunflower oil has a pH of 6.8, Water/Ice is 7 and salt has a pH of 8. Since we were limited with the fresh lemon juice, we created a lemon juice and water solution, which brings the lemon juice's pH level lower. This shows that as the substances with the higher acidity level will contribute to deteriorating the apple sample fast.

The limitations of the experiment is that we had a product limitation and thus only performed the experiment twice. This in turn could only give us evidence which is lightly supported. The location could also be a factor as we required to do the experiment in multiple locations. The weather is yet another restriction as it changed the sunlight and other uncontrollable issues.

Our experiment answers the question as it shows what substances are superior in terms of preservation, and what substances are the opposite.

Below are the results gathered:



Concentration of hydrogen ions compared to distilled water

Concentration	pH	Examples of solutions at this pH
10,000,000	pH = 0	battery acid, strong hydrofluoric acid
1,000,000	pH = 1	hydrochloric acid secreted by stomach lining
100,000	pH = 2	lemon juice, gastric acid, vinegar
10,000	pH = 3	grapefruit, orange juice, soda
1,000	pH = 4	tomato juice, acid rain
100	pH = 5	soft drinking water, black coffee
10	pH = 6	urine, saliva
1	pH = 7	"pure" water
1/10	pH = 8	sea water
1/100	pH = 9	baking soda
1/1,000	pH = 10	Great Salt Lake, milk of magnesia
1/10,000	pH = 11	ammonia solution
1/100,000	pH = 12	soapy water
1/1,000,000	pH = 13	bleaches, oven cleaner
1/10,000,000	pH = 14	liquid drain cleaner

The scale is courtesy of The Pacific Institute for the Mathematical Sciences

Method

- Gather all materials required.
- Divide apples into equal 10 gram slices using the knife and check the weight with the scale.
- Pour the substances into the cup. (2 cups for every substance) These are the amounts we poured in for each

Substances	Salt Water	Coke	Lemon Juice	Ice	Vinegar	Water	Oil	Nothing
Measurements	Fill the cup until line 1 with salt and fill the rest of the cup until line 4 with water.	Fill the cup until Line 3 with Coke.	Fill the cup with fresh lemon juice until line 1, and the rest of the cup until Line 4 with water.	Fill up the cup until Line 4 with water.	Fill the cup with vinegar until line 1.	Fill up the cup until Line 4 with water.	Fill the cup with oil until line 1.	
How much cups for each	x2	x2	x2	x2	x2	x2	x2	x2

substance:

- Submerge the apple slices into the substances (one 10g slice per cup)
- Store experiment on hard surface to avoid any spilling expect for the Ice, which needs to be stored in a freezer.
- Check experiment on a daily basis at 2:00pm and record results (colour) while taking pictures.
- Repeat experiment a few times, in order to get reliable results.

Validity	Reliability	Accuracy
Our test is valid as we did the experiment twice at the same time, under the same conditions.	We represented this experiment 2 in order to get reliable results.	To make our experiment more accurate, we should've used a more detailed colour scale and measure the amounts of liquid with a measuring cup in mL, for a more accurate.

- Variables:**
- Controlled Variables:**
- Type of cup used
 - Environment the experiment was stored in
 - Colour of apple (all started at colour 8 on the Colour Scale)
 - Apple type (pink lady)
 - Weight of apples at start (10 grams)
- Independent:**
- Substances (Lemon juice, Salt Water, Water, oil, Coke, Nothing, Ice, Vinegar)
 - Measurements of the substances.
- Dependant:**
- Colour of apple samples
 - Hardness of apple samples

Variations:

This experiment, similar to all experiments, experienced inconsistencies. Throughout our test flaws were inevitably encountered. The amount of sunlight given to the substances varied throughout the day. This change in sunlight can be resolved by placing the substances in a fair location. Though the sunlight was equally experienced by each substance regardless. Another issue experienced was the amount of each substance applied to the cups as we were limited in terms of materials. This can be improved by making sure you have more than enough equipment to use in case more is needed. The shape of the apple slice may alter the results also. The mass of the apples were equalised however the configuration can cause inconsistencies as some samples had more surface area than others, which means more exposure, to avoid this next time, be sure to cut samples all with the same amount of surface area and see if it affects the results. The bacteria would have also helped in rotting the apples. Evaporation of the liquids is another potential problem that could be addressed in the future. You can fix this by putting lids on the tops of the cups. We attempted to keep the experiment in the same location in order to prevent this.



Conclusion:

The results of the experiment determined that Ice is the best of the tested substances for preserving apple slices. Our hypothesis was supported, as the higher the acidity level, the faster the apple rotted and ICE did prove to be superior in terms of preservation of apple samples. However, if there's not enough acidity the substance won't contribute to preserving the apple sample, the sample will just carry rotting at normal rate. Saltwater **served to be the second** preservative. This was followed by Lemon Juice. Water, oil and the CONTROL were average in preserving the apple slices. And coke and vinegar however proved to be inferior in the preservation of apple slices as the acidity levels were too high.

List of Substances Superior in terms of preservation to inferior substances

1.	Ice
2.	Salt Water
3.	Lemon Juice
4.	Control
5.	Oil
6.	Water
7.	Coke
8.	Vinegar



