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Per. 7/8 A Science
Sept. 29, 2016

Title:

The Effect of Vinegar, Water, Orange Juice, and Lemon Juice (All With Salt) on How Well Pennies Are Cleaned

Purpose:

The purpose of the lab was to see whether or not different cleaning solutions (water, orange juice, and lemon juice) with salt would work as well as vinegar with salt. According to

http://cleaning.lovetoknow.com/Lemon_Juice_Pennies_Cleaning#Uiq2KickbpHyVLJK.9

by Heather Long, citric acid (which is present in both lemon juice and orange juice) can clean pennies, and it also may dissolve a small amount of copper. Heather Long also said that *all* citric acids should work, and that the recommended time to sit in the solutions is 5 minutes. According to

http://www.ehow.com/info_8135684_happens-clean-pennies-lemon-juice.html by Susan MacDowell, the pennies are brown because of copper oxide (when the oxygen and copper combine). Susan MacDowell says that the acids in the lemon juice (citric acid) breaks the bonds of the oxygen and the copper. Susan MacDowell also said that the salt increases the acidity of the liquids, so that the bonds connecting the copper oxide to the copper should break faster if the solution has salt. After considering these facts, it was hypothesized that if either lemon juice with salt or orange juice with salt was used instead of vinegar and salt, the pennies would be cleaned just as well.

Materials and Procedure:

Materials-Our Experiment:

- 8 cups
- 40 dirty pennies (5 per cup)
- 60 mL of water
- 60 mL of vinegar
- 60 mL of lemon juice
- 60 mL of orange juice
- 20 grams total of salt (5 grams per cup)
- Paper towels
- A sink
- 4 spoons (one per liquid)

Materials-Ms. Edery's Experiment:

- 1 cup
- 60 mL of vinegar

- 5 grams of salt

Procedure:

All cups will be the same size and shape. 60 mL of water, which is the control, will be poured into two plastic cups. Then, 5g of salt will be added to the water cups. The solution will be stirred until the salt dissolves. 60 mL of vinegar will be poured into two plastic cups. Then, 5g of salt will be added to the vinegar. The solution will be stirred until the salt dissolves. 60 mL of lemon juice will be poured into two plastic cups. Then, 5g of salt will be added to the lemon juice. The solution will be stirred until the salt dissolves. 60 mL of orange juice will be poured into two plastic cups. Then, 5g of salt will be added to the orange juice. The solution will be stirred until the salt dissolves. 5 old, tarnished pennies will be placed into each cup. The pennies will remain in the cups for 5 minutes. After 5 minutes, the pennies will be pulled out without any tools. If at least one of the pennies is cleaned, the results will be evaluated. If none of the pennies are cleaned, the pennies will be placed back into the cups for another 5 minutes. Repeat this until at least one of the pennies is cleaned. The shininess will be judged with the chart. Example: 16. This would be the 16th penny color, counting from left to right then down a row.

Experiment:

All cups were the same size and shape. 60 mL of water each was poured into two plastic cups. Then, 5g of salt was poured into each of the cups. The mixtures were then mixed with a spoon, and the spoon rinsed off. 60 mL of vinegar each was poured into two plastic cups. Then, 5g of salt was poured into each of the cups. The mixtures were then mixed with a spoon, and the spoon rinsed off. 60 mL of lemon juice each was poured into two plastic cups. Then, 5g of salt was poured into each of the cups. The mixtures were then mixed with a spoon, and the spoon rinsed off. 60 mL of orange juice each was poured into two plastic cups. Then, 5g of salt was poured into each of the cups. The mixtures were then mixed with a spoon, and the spoon rinsed off. 5 pennies were placed into each of the cups. Five minutes later, the pennies were pulled out of each of the cups using the spoons. Then each penny was described using the chart and data was recorded.

Data:

Trial 1: How the Cleaners Affect the Pennies' Shininess

Penny numbe	Water (how clean are the	Lemon Juice (how clean are	Orange Juice (how clean are	Vinegar (how clean are the pennies?)

r	pennies?) pH: 7.1	the pennies?) pH: 2.6	the pennies?) pH: 4.0	pH: 2.6
#1	5	9	3	5
#2	12	6	4	6
#3	14	8	5	6
#4	16	12	7	8
#5	17	18	10	10

Trial 2: How the Cleaners Affect the Pennies' Shininess

Penny number	Water (how clean are the pennies?) pH: 7.1	Lemon Juice (how clean are the pennies?) pH: 2.6	Orange Juice (how clean are the pennies?) pH: 4.0	Vinegar (how clean are the pennies?) pH: 2.6
#1	14	9	7	2
#2	17	5	8	3
#3	18	7	11	3
#4	19	13	17	4
#5	19	15	20	4

Average: How the Cleaners Affect the Pennies' Shininess

	Water (how clean are the pennies?) pH: 7.1	Lemon Juice (how clean are the pennies?) pH: 2.6	Orange Juice (how clean are the pennies?) pH: 4.0	Vinegar (how clean are the pennies?) pH: 2.6
Average:	15.1	10.2	9.2	5.1

Ms. Edery's Procedure's Pennies: How the Cleaners Affect the Pennies' Shininess

Penny number	Vinegar (how clean?) pH: 2.6
#1	7
#2	11
Avg.	9

Chart for Penny Shininess Ranking:



For the water and salt, there were two sets of data, trial 1 and trial 2. For penny number 1 in trial 1, the shininess ranking was 5. Penny number 2's ranking was 12, penny 3's ranking was 14, penny number 4's ranking was 16, and penny 5's ranking was 17. For trial 2, penny 1's ranking was 14, penny 2's ranking was 17, penny 3's ranking was 18, penny 4's ranking was 19 and penny 5's ranking was also 19. The average of the water and salt solution was a ranking of 15.1. For the lemon juice and salt trial 1, penny number 1's ranking was 9, penny number 2's ranking was 6, penny

number 3's ranking was 8, penny number 4's ranking was 12, and penny 5's ranking was 18. For lemon juice and salt trial 2, penny number 1's ranking was 9, penny number 2's ranking was 5, penny number 3's ranking was 7, penny number 4's ranking was 13, and penny number 5's ranking was 15. The average of lemon and salt was 10.2. For orange juice and salt trial 1, penny number 1's ranking was 3, penny number 2's ranking was 4, penny number 3's ranking was 5, penny number 4's ranking was 7, and penny number 5's ranking was 10. For orange juice and salt trial 2, penny number 1's ranking was 7, penny number 2's ranking was 8, penny number 3's ranking was 11, penny number 4's ranking was 17, and penny number 5's ranking was 20. The average for orange juice and salt was 9.2. For vinegar and salt trial 1, penny number 1's ranking was #5, penny number 2's ranking was 6, penny number 3's ranking was 6, penny number 4's ranking was 8, and penny number 5's ranking was 10. For vinegar and salt trial 2, penny number 1's ranking was 2, penny number 2's ranking was 3, penny number 3's ranking was 3, penny number 4's ranking was 4, and penny number 5's ranking was 4. The average of vinegar and salt was 5.1.

Discussion and Conclusion:

Seeing as the average shininess for water and salt was 15.1, the average for lemon juice and salt was 10.2, the average for orange juice was 9.2, and the average for vinegar and salt was 5.1, the hypothesis was not supported. The hypothesis that orange juice, lemon juice, and vinegar would all work just as well was not supported, as vinegar clearly cleaned the pennies much better than the other solutions. Clearly the solution affects how clean the pennies become. According to our data, vinegar is the best cleaner, despite the fact that lemon juice and vinegar have the same pH, 2.6. Time was also a factor. When the pennies were put into a solution of 60 mL of vinegar and 5g of salt for 5 minutes, the average shininess was 5.1, but when it was put in the same solution for 10 seconds the average shininess was only 9. This shows that the more time that the pennies are put into the solution, the more time the solution has to clean, cleaning it more thoroughly.

While this experiment was meant to be perfect, humans are not perfect, and therefore neither was this experiment. During this experiment, mistakes were made. When ranking the orange juice and salt solution for trial 1, some of the pennies were mixed with the untested pennies. They then had to be sorted based on what was thought to have been cleaned already and what was not. This opened the experiment to many errors, since if only two pennies were switched, the entire experiment would be incorrect. Some pennies thought to have been exposed to nothing may have already undergone the cleaning process. Another thing that could have changed the results is that the pennies may not have had the same amount of dirtiness to begin with. That means a penny with a shininess of 20 originally may have gone down to a 10, and while

that jump is amazing, a 10 is not that shiny and the cleaner would have been considered not that effective. A penny may also have started out as a 5, and only went to a 4. While the jump is very small, the data would only show that the penny is very clean and the cleaner very good. To conclude, the solution used to clean the pennies does matter, as vinegar seemed to have cleaned better than lemon juice and orange juice.

References:

- Long, Heather. "Instructions for Cleaning Pennies with Lemon Juice." LoveToKnow. N.p., n.d. Web. 05 Oct. 2016.
- MacDowell, Susan. "What Happens When You Clean Pennies With Lemon Juice?" EHow. Demand Media, n.d. Web. 05 Oct. 2016.

