

TO INVESTIGATE THE EFFECTIVENESS OF CITRIC JUICE MIXED WITH VINEGAR IN REMOVING NAIL POLISH

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1. ABSTRACT

Our purpose is to find a safer alternative to nail polish removers that contain acetone, a chemical that is harmful to our nails, one of the reasons being its overexposure which can result in damage to skin and nails. Our method was mixing citric fruits and vinegar in different ratios, removing the nail polish with a set number of strokes and observing how much nail polish was removed. We found that the mixture of lemon and vinegar in the ratio 2:1 was the most effective in removing nail polish. Thus, we concluded that there is a safer alternative to remove nail polish, although it takes a longer time to remove.

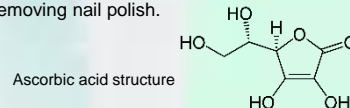
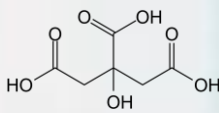
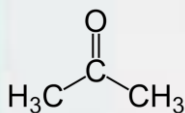
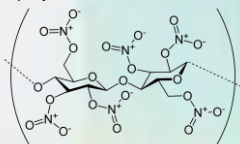
2. INTRODUCTION

Our project is about investigating whether citric juice which contains mainly citric acid, when mixed with vinegar, has the ability to remove nail polish from nails. This project was chosen because women paint and remove nail polish frequently, and so the results of this project will not just benefit us, but all other women. This will also appeal to our peers because we are from an all girls school. This investigation is important because nail polish removers contain acetone which is harmful. Overexposure of acetone can lead to damage of skin and nails, and affect the eyes due to its volatility. The strong fumes can lead to nausea and vomiting and may cause breathing difficulties. In extreme case, constant contact with acetone may cause cancer. Therefore, we feel that it is important to find an alternative for acetone that is organic and natural, in the form of citrus fruits.

3. THEORETICAL BACKGROUND

Acetone is the main chemical in a nail polish remover. Nail polish contains the polymer nitrocellulose. Different elements have different electro-negativities. Oxygen being slightly more electronegative than nitrogen, becomes δ^- while nitrogen becomes δ^+ in the polymer. The oxygen in the acetone becomes δ^- due to the higher electro-negativity of oxygen. This results in a dipole-dipole interaction between the acetone and polymer in the nail polish. The dipole-dipole interaction explains why acetone is able to remove the nail polish. Likewise, there is a dipole-dipole interaction between nitrocellulose and citric acid. The δ^- oxygen in the COOH and OH functional groups of the citric acid will be attracted to the δ^+ nitrogen in nitrocellulose in the nail polish, forming an interaction between the citric acid and nail polish, allowing the citric acid to remove the nail polish.

Another possible explanation is the lone pair of electrons in the nitrocellulose. Nitrocellulose has an ether linkage. The oxygen bonds with the two carbon atoms, forming covalent bonds. As oxygen has 6 valence electrons and only 2 valence electrons are bonded with the carbon atoms, the lone pair of electrons make the oxygen partially negative and the carbon becomes partially positive. Hence, the partially negative oxygen in the acetone is attracted to the partially positive carbon in the nitrocellulose, forming an interaction. The interaction could be strong enough to break the covalent bond, breaking down the polymer. When we used the acetone and citric juices to remove the nail polish, it came off as tiny flakes, suggesting that the structure of the polymer could have been destroyed.

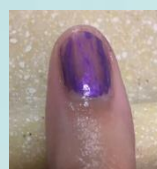


4. PROCEDURE

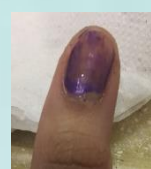
- Paint the nail (2 coats) and wait for 5 minutes. Simultaneously, take a picture of the painted nail for a control set-up.
- After 5 minutes, soak a cotton pad with the mixture of grapefruit juice and vinegar in the ratio of 2:1 respectively.
- Swipe the cotton pad over the painted nail 155 times in 1 minute.
- Record the amount of nail polish removed and take a picture of the nail after it has been swiped over.
- Repeat steps 1-4 using the 4 other types of citric juices:
Other citric fruit juices:
(a) Lemon (b) Lime
(c) Grape (d) Orange
- Observe and compare the data collected to deduce the effectiveness of each fruit juice in removing the nail polish.

5. RESULTS & DISCUSSION

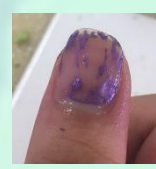
Fruit	Volume of fruit juice (ml)	Volume of vinegar (ml)	Ratio (fruit juice: vinegar)	Amount of nail polish removed
Grapefruit	2	1	2:1	¼ removed
Lime	2	1	2:1	½ removed
Lemon	2	1	2:1	almost fully removed
Orange	2	1	2:1	¼ removed
Grape	2	1	2:1	¼ removed



Grapefruit: Vinegar



Lime: Vinegar



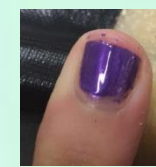
Lemon: Vinegar



Orange: Vinegar



Grape: Vinegar



Control set-up (painted nail)

We found that the mixture of lemon juice and vinegar in the ratio 2 : 1 gave us the best results as it removed almost all of the nail polish on the nail. The rest of the mixtures gave us results that were similar for the most part. We analysed the data collected by comparing the pictures and deciding which mixture removed the most polish. From there, we tried to gather more information on why that specific amount of lemon juice and that specific amount of vinegar worked the best.

The ratio, 2:1, is deduced through a series of experiments with other ratios of citrus juice and vinegar namely 3:1 and 4:1. Generally, most fruits remove nail polish well in the ratio of 2:1. When we used vinegar alone, the vinegar was hardly effective in removing nail polish. However, vinegar had to be present in all the citric juices to be effective in removing the nail polish. Both citric acid and vinegar contain the -COOH group, hence the ability of citric acid to remove nail polish may be due to the interactions of -OH present with nitrocellulose which vinegar does not have. Vinegar is likely to provide the optimum pH medium for the interactions between the citric acid and nitrocellulose.

Besides citric acid being present in all citric juices, lemon juice has ascorbic acid. From the structure of ascorbic acid, it has 4 -OH groups while citric acid has only one. The increased number of -OH groups in lemon juice would have increased the dipole-dipole interactions with nitrocellulose, hence lemon was the best in removing nail polish.

6. CONCLUSION

From our findings, we can conclude lemon and vinegar in the ratio of 2:1 respectively is the best in removing nail polish, although it may take a longer time to remove. There is indeed an alternative to nail polish removal and it will be useful for those who have run out of nail polish remover but really need to remove it or it can also be useful to those who want to protect their nails from the harmful chemicals. Further investigations that can be done as a follow-up are whether the process of removing the nail polish can be sped up and whether there is an odor-free method to removing nail polish as vinegar has a pungent smell which many people may not like. Another set of investigations can also be carried out to find out whether mixing citrus fruits will be more effective.