Oxalic Acid in Rhubarb Leaves

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INTRODUCTION

Titration is a technique that is used in this experiment and it is used to find the concentration of the oxalic acid. Titration is the slow addition of one solution with a known concentration to a known volume of another solution of unknown concentration, until the reaction reaches neutralisation, which is often indicated by a colour change. When the solution has a permanent colour change, this is known as the end point and it is when you stop titrating. The solution with the known concentration is called the titrant and it is also a standard solution, which in this case is the sodium hydroxide. After completing the experiment several times, concordant titres, which are the results within 0.5ml of each other, are averaged to find the amount of oxalic acid to find the concentration. In this experiment, the concentration of the oxalic acid is unknown which is why it is the aim of this practical.

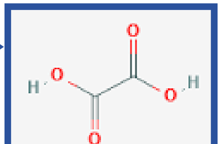
AIM

To determine the concentration present in the oxalic acid, which is extracted from the rhubarb leaves

BACKGROUND

Oxalic acid, also known as oxalate or ethanedioic acid, is an organic compound that can be found in many plants. The formula for oxalic acid is C2H2O4 or HOOCCOOH and its molar mass is 90.04g/mol. It is a transparent, colourless crystalline solid that often is a dihydrate. Oxalic acid is a diprotic acid which means it can donate two protons or hydrogen atoms per molecule to an aqueous solution. It is naturally found in our bodies and it can also be obtained from consuming different foods. There has been some research about oxalic acid binding with other minerals in our bodies after consumption, which can lead to several health problems for some individuals. The oxalic acid can bind with calcium and iron in our bodies which forms compounds and for most people, these compounds are eliminated from the body. Oxalic acid can increase your chance of getting kidney stones, it can reduce the amount of minerals your body is supposed to absorb and it isn't ideal to consume a large amount of this acid. Oxalic acid can be found in many household and industrial products and it is also known to remove rust.

Chemical Structure of Oxalic Acid



Source:
pubchem.ncbi.nlm.nih.gov

Extracted Oxalic Acid from Rhubarb Leaves

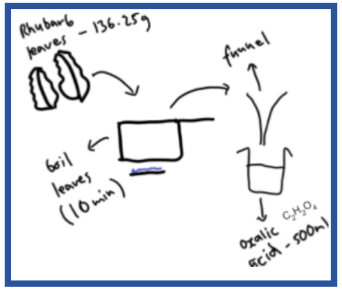
METHOD

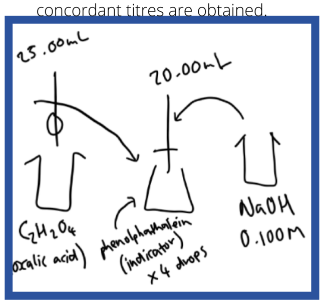
Extraction of the oxalic acid:

1. Collect and weigh fresh Rhubarb leaves (136.25g)
2. Place the leaves into a saucepan covered with water and boil for 10 minutes.
3. Strain and filter the boiled leaves collecting the filtrate.
4. Make the filtrate (oxalic acid extract) up to 500mL

Titration of the oxalic acid:

1. Pipette 25.00mL of the oxalic acid into a conical flask.
2. Fill the burette with 0.100 M sodium hydroxide
3. Add 4 drops of the indicator phenolphthalein to the conical flask
4. Record the initial volume of the burette and titrate until the end point, recording the final volume.
5. Repeat the above steps until 3 concordant titres are obtained.

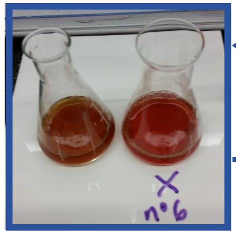




RESULTS

Final:	9.65	17.80	26.15	34.40
Initial:	1.35	9.65	17.80	26.15
Total:	8.30	8.15	8.35	8.25
Final:	13.20	21.85	30.10	38.40
Initial:	4.95	13.20	21.85	30.10
Total:	8.25	8.65	8.25	8.30

The results are measured in ml and out of the 8 trials of titration, there was only one outlier which was 8.65ml. Therefore, only 7 of the titration results were used to figure out the calculation and the concentration of the oxalic acid.



Difference between titration and outlier titres

Conical flasks with oxalic acid solutions

CALCULATIONS

1. The calculation of the average titre of the data using the concordant titres

Average = 8.30 + 8.15 + 8.35 + 8.25 + 8.25 + 8.25 + 8.30 / 7 = 8.264 ml

2. The calculation of the concentration of the oxalic acid extract

C2H2O4 + 2NaOH => Na2C2O4 + 2H2O

n = c x v

n(2NaOH) = 0.100 x 8.264/1000n(2NaOH) = 8.264 x 10^-4

n(C2H2O4) / n(2NaOH) = ½

n(C2H2O4) = ½ x n(2NaOH)

n(C2H2O4) = ½ x 8.264 x 10^-4

n(C2H2O4) = 4.132 × 10^-4

Conc(C2H2O4) = 4.132 × 10^-4 / 25.00/1000 = 4.132 × 10^-4 / 0.025 = 0.0165 mol/L -> concentration of oxalic acid

3. What mass of oxalic acid is in 1.00 L

Mass / L: mass = n x Mr = 0.0165 x 90 = 1.485g/L

4. What mass of oxalic acid is in the 500.0 mL / 136.25 g of rhubarb leaves

Mass / L = Mass / 500ml

1.485 / 2 = 0.7425g/500ml

5. The calculation of the mass of oxalic acid per 100g of rhubarb leaves

Mass / 136.25g = Mass / 100g

0.7425 / 136.25 = Mass / 100g

0.7425 / 136.25 x 100g = Mass

Mass = 0.5450g / 100g

SUMMARY TABLE

Mass of Rhubarb Leaves:	136.25g
Volume of extract:	500ml or 0.5L
Aliquot size:	25.00ml
Average titre:	8.264ml
Concentration of oxalic acid extract:	0.0165 mol/L
Mass of oxalic acid in 1.00 L:	1.485g/L
Mass of oxalic acid in the 500.0 mL / 136.25 g of rhubarb leaves:	0.7425g/500mL
Mass of oxalic acid per 100g of rhubarb leaves:	0.5450g / 100g

ERRORS

An error that was made in this experiment was one of the titres being an outliner and this occurred during the titration of the sodium hydroxide and the oxalic acid, however it is difficult to conclude which part of the experiment went wrong in this step. This impacted the experiment because only 7 of the total results were used to figure out the calculations since one of them wasn't a concordant titre.

IMPROVEMENTS

An improvement that could be done for this experiment is controlling the other variables so that they don't impact the outcome of the experiment. Since the final rhubarb leaves were from the third trial, if the variables from the first two trials were controlled, it would have made the experiment more efficient. However, the experiment still worked well and the concentration of the oxalic acid was able to be found from the calculations.

CONCLUSION

From the experiment, it was found that the concentration of the oxalic acid was 0.0165 mol/L. This experiment was able to find the concentration of the oxalic acid, which was extracted from rhubarb leaves. As well as the concentration of the oxalic acid, other calculations such as the amount of oxalic acid in 1.00L, the mass of oxalic acid in 500ml and the mass of oxalic acid per 100g of rhubarb leaves, were also able to be found through this experiment.

Straining the rhubarb leaves after boiling

Filtrating the boiled rhubarb leaves

Difference between the oxalic acid before and after titration (right = after, left = before)

GLOSSARY

Titration - the slow addition of one solution with a known concentration to a known volume of another solution of unknown concentration until the reaction reaches neutralisation, which is often indicated by a colour change

Standard solution - a solution with a known concentration

Burette - a graduated glass tube with a tap at one end, for delivering known volumes of a liquid, especially in titrations

Pipette - a tool used to transport a measured volume of liquid

Aliquot - a portion of a larger whole, especially a sample taken for chemical analysis or other treatment

Mole - A mole of a substance or a mole of particles is defined as exactly 6.02214076×10^{23} particles, which may be atoms, molecules, ions, or electrons

Concentration - a measure of the concentration of a chemical species, in particular of a solute in a solution, in terms of amount of substance per unit volume of solution

Endpoint - refers to the point at which the indicator changes color in a colorimetric titration

Tirant - a solution of known concentration that is added (titrated) to another solution to determine the concentration of a second chemical species

Concordant titres - titres that are within 0.5ml of each other

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