The amount of Oxalic Acid in Rhubarb leaves

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AIM:

To investigate the unknown concentration and mass of Oxalic Acid in Rhubarb leaves through the technique of titrating it against NaOH (sodium Hydroxide).

INTRODUCTION:

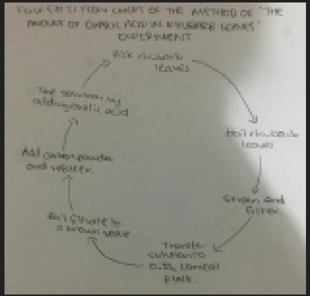
In the experiment, we look at the scientific technique of titration. Titration is the addition of one solution of a known concentration, slowly, to a known volume of another solution of unknown concentration until the reaction starts to neutralise. Since the neutralisation occurs between an acid and base, the equivalence point, the point at which the chemically equivalent quantities of acid and base have been mixed, can be seen as a colour change which marks the endpoint, at the exact point where the solution is neutralised, stoichiometrically equivalent mole amounts of acid and base have reacted with each other Therefore the process of titration is beneficial in ascertaining the exact concentration of one solution. The apparatus usually used in most titrations including this one is a burette(in which the Sodium hydroxide was), and an aliquot of oxalic acid was used to then titrate multiple times in order to find the concordant titres. The balanced equation for the acid-base reaction involved in the standardization procedure is $H_2C_2O_4(aq) + 2\ NaOH(aq) \rightarrow Na_2C_2O_4(aq) + 2\ H_2O(l)$ This equation specifies that there are two moles of H+ supplied by each mole of oxalic acid in this reaction (since 1 mole of H+ is consumed per mole of NaOH)

BACKGROUND INFORMATION:

Oxalic acid ($C_2H_2O_4$) also known as ethanedioic acid is a white, crystalline toxic organic compound that belongs to the family of carboxylic acids and forms a colourless solution in water. Oxalic acid is widely used as an acid rinse in laundries, where it is effective in removing rust and ink stains because it converts most insoluble iron compounds into a soluble complex ion.Oxalic acid is found in many vegetables, cocoa, fruits seeds and leafy greens. One of its main properties is that it isis soluble in water at 20°C (90-100 g/L). Once consumed, oxalate can bind to minerals to form compounds, including calcium oxalate and iron oxalate. For most people, these compounds are then eliminated in the stool or urine. However, for sensitive individuals, high-oxalate diets have been linked to an increased risk of kidney stones and other health problems. Rhubarb (Rheum rhabarbarum) which is a stalk fruit that is consumed in various forms, probably most famously with custard, has an undeniable acidity that has always been apparent when eating the fruit. This acidity comes from Oxalic acid, this prac seeks to determine the exact concentration of Oxalic Acid in rhubarb leaves.

METHOD/FLOW DIAGRAM:

1) Pick some Rhubarb leaves
2) Boil your rhubarb leaves
3) Strain and filter the filtrate to remove finer particles
4) Put your solution into a 0.500 L conical flask
5) Now boil your filtrate to a known value
6) Now titre the solution by adding oxalic acid to it until a colour change is seen



RESULTS:

	1	2	3	4	5	6	7	8
Final Volume	9.65	17.80	26.15	34.40	13.20	21.85	30.10	38.40
Initial Volume	1.35	9.65	17.80	26.15	4.95	13.20	21.85	30.10
Titre	8.30	8.15	8.35	8.25	8.25	8.65	8.25	8.30

Note:The ones in red are not concordant and may comen about as a result of systematic or random errors

CALCULATIONS:

1) the calculation of the average titre of the data using the concordant titres

The average titre was calculated by using the concordant titres(which is the volume of three or more titres that lie within 0.05ml), from the above table to find the arithmetic mean.

8.30+ 8.15+ 8.35+ 8.25+ 8.25+ 8.25+ 8.30/7=8.26429

Therefore, the average titre was 8.26429mL

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

Balanced Equation: $C_2H_2O_4 + 2NaOH \Rightarrow Na_2C_2O_4 + 2H_2O$

The formula for concentration is c=n/v, however we must first calculate the n(which is the moles)

n=c x v

n(2NaOH)=0.100 x 8.264/1000

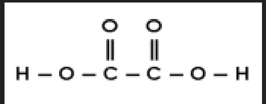
n(2NaOH)=8.264 x 10^-4

n(C2H2O4)/n(2NaOH)=½

n(C2H2O4)=½ x n(2NaOH)

n(C2H2O4)=½ x 8.264 X 10^-4

n(C2H2O4)=4.132 x 10^-4



Oxalic Acid, $H_2C_2O_4$

Concentration(C2H2O4)=4.132 x 10^-4/25.00/1000

=4.132 x 10^-4/0.025

=0.0165 mol/L

Therefore, the concentration of oxalic acid is 0.0165 mol/L

3. the calculation of what mass of oxalic acid in 1.00L.

Mass/L: mass = n*Mr

= 0.0165 *90

=1.485 g/l

4. The calculation of what mass of oxalic acid in 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/ 136.25 = Mass /100g

0.7425 / 136.25 = Mass / 100g

0.7425/136.25 *100 = Mass

Therefore mass of oxalic acid per 100g of rhubarb leaves is 0.5450g/100g

SUMMARY TABLE:

Mass of leaves	136.25 g
Volume of extract	0.500 L
Aliquot size	20.00 mL
Average titre	8.26 mL
The concentration of oxalic acid extract	0.0165 mol/L
Oxalic acid per 100g rhubarb leaves	0.5450g

ERRORS:

There are a few errors in the experiment. These include concentration errors. These can happen when we use the wrong concentration, to begin with, and this can occur when it evaporates or there is a chemical decomposition. In this experiment, the chemical decomposition would've been the rhubarb leaves going mouldy. Another error would be not cleaning equipment properly as if it carried the wrong solution then it can affect the concentrations of the solutions being experimented on.

IMPROVEMENTS:

To improve this experiment, we must try to keep the solution in a cool environment so the concentration does not change as it will not evaporate. Another improvement could be making sure that the equipment being used is thoroughly clean and is empty so no other substances are mixed in with the solution.

CONCLUSION:

In conclusion, the standardized solution of Sodium hydroxide(NaOH), with a known molarity of 0.100M was used to determine the unknown mass and concentration of oxalic acid in rhubarb leaves by titrating the two solutions together. By conducting the experiment it was found that there was 0.5450g of oxalic acid per 100g of rhubarb leaves. The concentration of extract of oxalic acid was also calculated to be 0.0165 mol/L. Random errors were present in this lab due to the impossibility of making a perfect measurement; this was prevalent to the titration process, which includes measurement of the volume used out of the burette. Systematic error was also present in the titration process due to subjective analysis of the titration process, especially the identification of the end point as opposed to the equivalence point.

GLOSSARY:

Titration: A titration is a technique where a solution of known concentration is used to determine the concentration of an unknown solution. Typically, the titrant (known solution) is added from a burette to a known quantity of the analyte (the unknown solution) until the reaction is complete. Knowing the volume of titrant added allows the determination of the concentration of the unknown. Often, an indicator is used to usually signal the end of the reaction, the endpoint.

Titre: A titre is the total volume of solution delivered by the burette (burette) to reach the end of the titration. It may also be the minimum volume of a solution needed to cause a particular result in titration(in this case it was the volume of solution needed to create a permanent colour change in the indicator) The volume of solution added is then referred to as the titre value; multiple titres are usually taken until concordant results are obtained.

Aliquot: In terms of chemistry, an 'Aliquot' is essentially just a term employed to describe a sample/exact portion of liquid that is taken or extracted from an original sample(It is taken with a pipette from a measured flask) In other words, an aliquot is predominantly a fractional part of an entire whole sample. Strictly speaking, it is when the fractional part is an exact divisor of the whole; the term 'aliquant' is used when the fractional part is not an exact divisor of the whole For example, let's say we have a 100ml solution of sodium hydroxide (NaOH) and decide that we only want to work with smaller 20ml samples. The 20ml samples would be our aliquots as they are the part to the total NaOH solution. Similarly, you could also say that the 100ml of sodium hydroxide can be divided into 5 aliquots.

Standard Solution: In analytical chemistry, a standard solution is a solution containing a precisely known concentration of an element or a substance.

Concordant Titre: Concordant titres are the volume of three or more titres that lie within 0.05ml of each other.

End point: An end point of a titration is when the reaction is complete, often marked by a colour change.

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