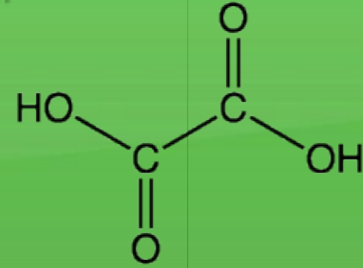


How much oxalic acid is present in rhubarb leaves?

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Aim: To determine the amount of oxalic acid in rhubarb leaves through the use of titration.

Background: Oxalic acid is a diprotic acid that has the molecular formula of $C_2H_2O_4$. Its molar mass is 90.03g/mol. It is the simplest dicarboxylic acid, and consists of just two carboxylic acid groups (COOH) directly attached to each other at the carbon atoms.



Oxalic acid is found in several natural resources, including rhubarb leaves, such as: plants, vegetables, leaves, wood, and coal. It is also produced in the body by metabolism by ascorbic acid or glyoxylic acid.

Oxalic acid is an odourless, crystalline white solid with a density of 1.9 g/ml and a melting point of 100 degrees Celsius.

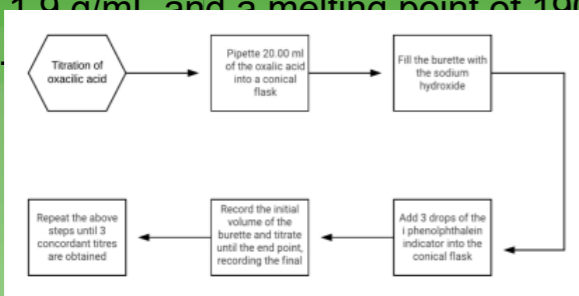
Method:

Extraction of the oxalic acid

1. Collect and weigh fresh Rhubarb leaves (136.25 g)
2. Place the leaves into a saucepan cover with water and boil for 10 min
3. Strain and filter the boiled leaves collecting the filtrate
4. Make the filtrate (oxalic acid extract) up to 500.0 ml

Titration of the oxalic acid

1. Pipette 20.00 ml of the oxalic acid into a conical flask
2. Fill the burette with the 0.100 M sodium hydroxide
3. Add 3 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

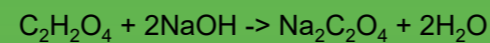


Results: all measures are in mL

Final	9.67	17.80	26.15	34.40	13.20	21.85	30.10	38.40
Initial	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

136.25g of rhubarb leaves was boiled down to 500.0mL. 25.00 mL aliquots of the rhubarb leaves extract was used in each titration. 4 drops of Phenolphthalein indicator was used.

Calculations:



$$n_{NaOH} = 0.100 \text{ (molarity)} * 8.3/1000 - \text{To adjust to L}$$

$$n_{NaOH} = 0.00083$$

$$n_{NaOH} = 8.3 * 10^{-4}$$

$$n_{C_2H_2O_4} / n_{NaOH} = \frac{1}{2}$$

$$n_{C_2H_2O_4} = \frac{1}{2} * n_{NaOH}$$

$$n_{C_2H_2O_4} = \frac{1}{2} * 8.3 * 10^{-4}$$

$$n_{C_2H_2O_4} = 4.15 * 10^{-4}$$

$$\text{conc } C_2H_2O_4 = n/V$$

$$\text{conc } C_2H_2O_4 = 4.15 * 10^{-4} / (25.00/1000)$$

$$\text{conc } C_2H_2O_4 = 0.0166M$$

$$\text{Mass} = n * M_r$$

$$\text{Mass} = 0.0166 * 90.0$$

$$\text{Mass} = 1.494g/L$$

$$\text{Mass} = 1.494g/1000mL$$

$$\text{Mass} = 0.747g/500mL$$

$$0.747g/500mL = 0.747g/136.25g - \text{As the filtrate was boiled from}$$

$$0.747g/136.25 = x/100g$$

$$0.747 * 100 / 136.25 = x$$

$$x = 0.548...$$

$$\text{Mass} = 0.55g/100g$$

Summary table:

Mass of leaves	136.25g
Volume of extract	500mL
Aliquot size	25.00mL
Average titre	8.3mL
Concentration of oxalic acid extract	0.0166M
Mass of oxalic acid per 100g of rhubarb leaves	0.55g



Conclusion:

Through the use of titration, it was found that there was approximately 0.55 grams of oxalic acid present within every one-hundred grams of rhubarb leaves.

Glossary:

Filtrate: The liquid collected, as opposite to the slimy substances in the bottle.

Titration: A process of determining the concentration of a dissolved substance in terms of the smallest amount of mixture of known concentration required to give an effect, usually colour change, with a known volume of the test solution.

End point: The point in a titration at which a reaction is complete, usually indicated by colour change.

Titre: The minimum volume a solution needs to reach the end point in a titration.

Concordant: Consistent

Pipette: A slim tube incorporating a bulb, for transferring or measuring small quantities of liquid.

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