KENDRIYA VIDHYALAYA KANCHANBAGH

CHEMISTRY INVESTIGATORY PROJECT

NAME: R.Chandrasekhar
CLASS: XII A
ROLL NO:
SESSION: 2024-25

CERTIFICATE

It is certified that R.Chandrasekhar, of class XII of Kendriya Vidyalaya Kanchanbagh has completed this project under the guidance and supervision of Mr. Sunil Vodela with great diligence.The project for the subject of Chemistry titled “Study of the Presence of Oxalate Ions in Guava Fruit at Different Stages of Ripening” is up to the standards of the Central Board of Secondary Education and can be sent for evaluation.

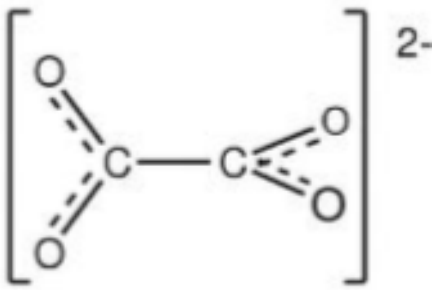
Examiner Teacher

AKNOWLEDGEMENT

I would like to express my special thanks to my chemistry teacher, Mr. Sunil Vodela, who gave me the golden opportunity to do this wonderful project on the topic “Study of the Presence of Oxalate Ions in Guava Fruit at Different Stages of Ripening”, which helped me in learning a lot of new things.Secondly I would also like to thank my parents and friends who helped me a lot in finalising this project within the limited time frame.

INTRODUCTION

Guava is a common tropical fruit cultivated in many tropical and subtropical regions. The common guava Psidium guajava (lemon guava, apple guava) is a small tree in the myrtle family (Myrtaceae), native to Mexico, Central America, the Caribbean and northern South America. It is a rich source of oxalate and its content in the fruit varies during different stages of ripening. Oxalate (IUPAC: ethanedioate) is an anion with the formula $C_2O_4^{2-}$. This dianion is colourless. It occurs naturally, including in some foods.



MATERIALS AND METHODS

❖ **Chemicals required**:

Dilute H_2SO_4, N/20 $KMnO_4$ Solution.

❖**Apparatus Required**:

100 ml measuring flask, pestle and motor beaker. Filtration flask, funnel, burette,

pipette, filter paper.

❖ **Materials Required**:

Pulp of guava at various stage of ripening, 0.005N $KMnO_4$ and dil. H_2SO_4.

Theory

Oxalate ions are extracted from the fruit by boiling pulp with dilute H_2SO_4. Then oxalate ions are estimated volumetrically by the solution with standard $KMnO_4$ solution.

Potassium permanganate is a strong oxidising agent and in the presence of sulfuric acid it acts as a powerful oxidising agent. In acidic medium the oxidising ability of $KMnO_4$ is represented by the following equation

In acidic solution,

$$MnO_4^- + 8H^+ + 5e^- \text{ — } Mn^{2+} + 4H_2O$$

Solution containing MnO_4^- ions are purple in colour and the solution Containing Mn^{2+} ions are colourless and hence the permanganate solution is decolourised when added to a solution of a reducing agent. The moment there is an excess of potassium permanganate present the solution becomes purple. Thus, $KMnO_4$ serves as a Self indicator in acidic solution.

Potassium permanganate is standardized against pure oxalic acid. It involves a redox reaction. Oxalic acid is oxidised to carbon dioxide by KMnO,, which itself gets reduced to MnSO,. Oxalic acid reacts with potassium permanganate in the following way.

The chemical reaction at room temperature is given below.

Reduction Half reaction:-

$2KMnO_4 + 3H_2SO_4 \text{ — >} K_2SO_4 + 2MnSO_4 + 3H_2O + S[O]$

Oxidation Half reaction:-

$5(COOH)_2 + 5[0] \text{ — >} 5H_2O + 10CO_2$

The overall reaction takes place in the process 1s

Overall reaction:-

$2KMnO_4 + 3H_2SO_4 + 5(COOH)_2 \text{ — >} K_2SO_4 + 2MnSO_4 + 8H_2O + 10CO_2$

The ionic equation involved in the process is given below.

Reduction Half reaction:- $[MnO_4^- + 8H^+ + 5e^- \text{ — >} Mn^{2+} + 4H_2O] \times 2$

Oxidation Half reaction:-

$[C_2O_4^{2-} \text{—} > 2CO_2 + 2e^-] \times 5$

Overall Ionic reaction:-

$2MnO_4 + 16H^+ + 5C_2O_4^{2-} \text{—} > 2Mn^{2+} + 10CO_2 + 8H_2O$

This titration cannot be carried out in the presence of acids like nitric acid or hydrochloric acid because itself is an oxidising agent. So hydrochloric acid chemically reacts with KMnO4 solution forming chlorine which is also an oxidising agen

Procedure

- Weigh 50 g of fresh guava and crush it to a fine pulp using pestle and mortar.
- Transfer the crushed pulp to a beaker and add about 50 ml dilute H_2SO_4 to it.
- Boil the content for about 10 minutes. Cool and filter the contents in a 100 ml measuring flask.
- Make up the volume 100 ml by adding ample amounts of distilled water.
- Take 20 ml of the solution from the flask and add 20 ml of dilute sulphuric acid to it.
- Heat the mixture to about 60°C and titrate it against (N/10) $KMnO_4$ solution taken in a burette till the end point has an appearance of pink colour.
- Repeat the above experiment with 50 g of 2 day and 3 day old guava fruits.

Observations

- Weight of the guava fruit each time was 50 g.
- Volume of guava extract taken for each titration was 10 ml. Normality of $KMnO_4$, solution was (1/10).
- End point : Colour changes to pink.
-

Guava solution	Initial reading	Final reading	Volume of $KMnO_4$
Raw	150	18	132
Semi-ripened	150	13	137
Ripened	150	10.8	13

Calculations

- **For raw guava**,

  $N_1V_1 = N_2V_2$

  => $N_1 \times 10 = (1/10) \times 132$

  => $N_1 = 132/100 = 1.32$

  Strength of oxalate in fresh guava extract = normality x Eq. mass of oxalate ion = 1.32 /100 x 44g / litre of diluted extract = 0.581g L^{-1}

- **For semi-ripened guava**,

  $N_1V_1 = N_2V_2$

  => $N_1 \times 10 = (1/10) \times 137$

  => $N_1 = 137/100 = 1.37$

  Strength of oxalate in one day old guava extract = 1.37/100 x 44 g/ litre of diluted extract = 0.603 gL"!

- **For ripened guava**,

  $N_1V_1 = N_2V_2$

  => $N_1 x\ 10 = (1/10) \times 139$

  => $N_1 = 139/100 = 1.39$

  Strength of oxalate in ripened guava extract = 1.39 /100 x 44 g/ litre

  of diluted extract = 0.612 gL^{-1}

Result

Normality of oxalate ion:

- ❖Fresh guava solution = 1.32 N
- ❖Semi - ripen guava solution = 1.37 N
- ❖ Ripened guava solution = 1.39 N

Strength of oxalate ion:

- ❖ Fresh guava solution is = 0.58 gL^{-1}
- ❖ Semi - ripen guava solution is = 0.60 gL^{-1}
- ❖ Ripened guava solution is = 0.61 gL^{-1}

Conclusion

- The content of oxalate ions in guava was found to be 59.67 percent, which is close to the literature value of 60 percent.
- It was also noticed that the content of oxalate ions grows with ripening of guava.

Precautions

- There should be no parallax while taking measurements.
- Spillage of chemicals should be checked.
- Avoid the use of burette having a rubber tap as $KMnO_4$ attacks rubber.
- In order to get some idea about the temperature of the solution touch the flask with the back side of your hand, when it becomes unbearable to touch the required temperature is reached.
- Add about an equal volume of dil H,SO, to the guava extract to be titrated (say a full test tube) before adding $KMnO_4$.
- Read the upper meniscus while taking burette reading with $KMnO_4$ solution.
- Incase, on addition of $KMnO_4$ a brown ppt. appears, this shows that either H_2SO_4 has not been added or has been added in insufficient amount. In such a case, throw away the solution and titrate again.

Bibliography

- Wikipedia
- NCERT Textbook of Chemistry for Class XII - Part I
- NCERT Science Laboratory Manual of Chemistry for Class XII
- Navis, M. S., & Subila S. (2017, January). Study on the presence of
- oxalate ions in guava and sapota fruits. International Journal of Advanced Science and Research, 2(1), 15-17