Chemistry Investigatory Project

Impartial Fulfilment Of Class 12th (CBSE)

Deep Memorial Public School (2015-2016)

CERTIFICATE

This is to certify that **AMAN SINHA** , a student of class **XII-A** has successfully completed the research on the below mentioned project under the guidance of **Mrs. Priyanka Srivastav** (Subject Teacher) during the year 2015-2016 in partial fulfillment of chemistry practical examination conducted by AISSCE, New Delhi.

Signature Of External Examiner

Signature Of Chemistry Teacher

Acknowledgement

omplishment of this project successfully, many people have best owned upon me their blessings and the
upport, this time I am utilizing to thank all the people who have been concerned with project.

y I would thank god for being able to complete this project with success. Then I would like to thank my
Mr. P. Kumar and Chemistry teacher **Mrs. Priyanka Srivastav**, whose valuable guidance has been
d me patch this project and make it full proof success his suggestions and his instructions has served a
tributor towards the completion of the project.

ould like to thank my parents and friends who have helped me with their valuable suggestions and guid
ul in various phases of the completion of the project.

not the least I would like to thank my classmates who have helped me a lot.

Name :- Aman Sinha

Date :- 9^{th} July 2015

INDEX

Study Of Oxalate Ions In Different Guava Samples

Aim Of The Experiment

To study the presence of Oxalate Ions in Different Guava Samples

Introduction

Guava is a sweet, juicy and light dark green colored fruit, when ripe it acquires a yellow color & has a penetrating strong scent. The fruit is rich in vitamin C & minerals. It is a rich source of oxalate and its content in the fruit varies during different stages of ripening.

In this project, we will learn to test for the presence of oxalate ions in the guava fruit and how it amount varies during different stages of ripening.

Theory

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

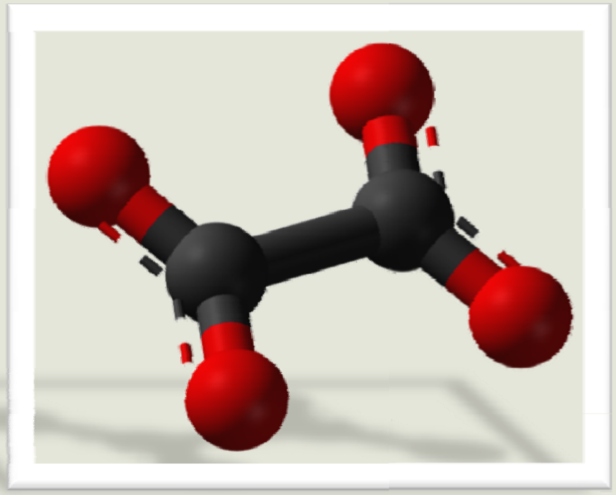

fig:- oxalate ion

Requirements
OR
Apparatus Required

100 ml. Measuring flask, pestle & mortar, beaker, titration flask, funnel, burette, weight-box, pipette, filter paper, dilute H_2SO_4, N/20 $KMnO_4$ solution, guava fruits at different stages of ripening.

Procedure

1) Weigh 50.0 g of fresh guava & crush it to a fine pulp using pestle-mortar.
2) Transfer the crushed pulp to a beaker & add about 50 ml. dil. H_2SO_4 to it. Boil the contents for about 2 minutes.
3) Cool & filter the contents in a 100 ml. measuring flask. Make the volume up to 100 ml. by adding distilled water.
4) Take 20 ml. of the solution from the measuring flask into a titration flask& add 20 ml. of dil.H_2SO_4 to it. Heat the mixture to about 60^oC & titrate it against N/20 $KMnO_4$ solution taken in a burette.
5) END POINT: appearance of permanent Light-Pink color.
6) Repeat the exp. With 50.0 g of 1, 2 & 3 days old guava fruit.

Observations & Calculations

nt of Guava Fruit taken:- 50.0 g

ne of guava extract in titration:- 20.0 ml

ality of $KMnO_4$ Solution:- 1/20

Guava extract from	Burette Readings	
Initial	Final	Con. Vol. of N/20 $KMnO_4$
Fresh Guava		
1 day Guava		
2 day Guava		
3 day Guava		

. Guava,

xtract) $N_1V_1 = N_2V_2$ ($KMnO_4$ sol.)

10 = 1/20 x (X)

y of Oxalate, $N_1 = (X)/200$

To be continued in next page.....

- Strength of Oxalate in **Fresh guava extract**,

= Normality x Eq. mass of oxalate ion

= (X)/200 x 44

= /200 x 44

= ___ g/l. of the diluted extract

To be continued in next page.....

- Strength of Oxalate in <u>1 Day guava extract</u>,

= Normality x Eq. mass of oxalate ion

= (X)/200 x 44

= /200 x 44

= ___ g/l. of the diluted extract

To be continued in next page.....

- Strength of Oxalate in **<u>2 Day guava extract</u>**,

= Normality x Eq. mass of oxalate ion

= (X)/200 x 44

=   /200 x 44

=   ___ g/l. of the diluted extract

To be continued in next page.....

- Strength of Oxalate in <u>3 Day guava extract</u>,

= Normality x Eq. mass of oxalate ion

= (X)/200 x 44

= /200 x 44

= ___ g/l. of the diluted extract

Result

- Strength of Oxalate ion in,
  - Fresh Guava: ______g/l.
  - 1 Day Guava: ______g/l.
  - 2 Day Guava: ______g/l.
  - 3 Day Guava: ______g/l.
- Presence of oxalate ion is high in guava, about _____% of guava contains oxalate ions, amount of oxalate ion decreases as it ripens!!!

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International Journal of Advanced Science and Research
ISSN: 2455-4227, Impact Factor: RJIF 5.12
www.allsciencejournal.com
Volume 2; Issue 1; January 2017; Page No. 15-17

Study on the presence of oxalate ions in guava and sapota fruits

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Abstract

The oxalate content of guava and sapota fruits at different stages of ripening were found out by permanganometric method. Oxalate rich foods are usually restricted to some degree, particularly in patients with high urinary oxalate level. Guava and sapota fruit have the highest percentage of vitamin C among citrus fruits. It also contains oxalate amount of which varies with ripening of the fruit. During ripening of guava and sapota fruit; the oxalate content increases progressively and the fully ripe fruit has the maximum oxalate content. Oxalate form an insoluble complex with calcium in the urine, or hyper-oxaluria, is even more important to stone formation than high levels of calcium or hypercalcicuria. Excessive intake of food and drink containing oxalate leads to calcium oxalate stone. Also, excessive intake of vitamin C which metabolized to oxalate may lead to hyper calcicuria and an increase in stone formation. Pain medications can be prescribed for symptom relief. Surgical techniques have also been developed to remove kidney stones.

Keywords: permanganometric method, hyper-oxaluria, hypercalcicuria, vitamin C etc.

1. Introduction

Oxalate (IUPAC ethandionate) is the dianion with the formula $C_2O_4^{2-}$ also written as $(COO)^{2-}$ 2. either name is often used for derivation, such as salts of oxalic acid for example, sodium oxalate $2((Na)^{+2}C_2O_4^{2-})$ or esters. For example, Dimethyl oxalate $((CH_3)_2C_2O_4$ also forms coordination compounds where it is abbreviated as ox. Many metal ions from insoluble precipitates with oxalate, a prominent example calcium oxalate, the primary constituents of most common kind of kidney stones. Guava, a native of Central America was introduced to India in the 17th century and lea became naturalised in the state of, Bihar. It is a small profusely branched tree, bearing solitary white flowers. The fruits are medium sized globoze with whitish greenish skins. The fruits in a berry with a pulpy edible meso. The guava plant is extremely hardy and can tolerate prolonged dry and drought periods, but not frost. It requires 60.80 inches of rain full. It is capable of growing in poor alkaline or poorly drained soils with p^H ranging from 4.5 to 7.5. The plant is propagated by stem and stem cutting. It is a more successful method of cultivation. The plant yields fruits twice a year. The important varieties are Allahabad Safeda, Chiffidas, Lucknow 49, Hafsi, Harijha, Habshie etc. Sapota in a large and highly ornamental evergreen tree that can reach a night of 15 to 45 metre. It is mainly propagated by grafting. Which ensures the new plant has the same choolaeteristic as the parent, especially its fruit, as it doesnot grow true to seed. It is also considerably faster than growing trees by seed, producing fruit in 3 to 5 years, growns from seed needs seven years of growth. In florida, the fruit is zaarrested from May to July with some cultivars available all years.

2. Objectives of the study

i) To study the oxalate content in Guava fruit and Sapota fruit.
ii) To compare the oxalate content of different days ripened Guava and Sapota fruit.

3. 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 and sapota fruits at different stage of ripening, 0.005N $KMnO_4$ and dil. H_2SO_4.

Methodology

Procedure

The first step is to standardised $KMnO_4$. In order to stadardise the N/20 $KMnO_4$ solution we prepare 0.05N oxalic acid.

Preparation of standard oxalic acid:

Weight accurately about 1.2g of oxalic acid and make up into 200ml standard flask using distilled water.

Standardisation of $KMnO_4$
(Standard oxalic acid x $KMnO_4$)

Fill up the burette with potassium permanganate solution after washing and rinsing the burette. Pipette out 20 ml of standard oxalic acid solution in to a clean conical flask. Add an equal volume of dilute sulphuric acid and heat the mixture at 60°C. Titrate against potassium permanganate solution. The end point is the appearance of permanent pale pink colour. Repeat the titration to get concordant value and calculate the normality of potassium permanganate solution.

Standardisation of Free oxalate ion present in the given fruit pulps

Procedure

Oxalate ions are extracted from the fruit by boiling pulp with dil. H_2SO_4. Then oxalate ion are estimated volumetric by titrating the solution with standard Kmno$_4$ solution.

Weight 50.0 gm of fresh guava and crush is to a fine pulp using pestle motor. Transfer the crushed pulp to a beaker and add about 50 ml dil. H_2SO_4 to it. Boil the content for about 10 min. Cool and filter the content up to 100 ml measuring flask make the volume up to 100 ml by adding distilled water. Pipette out 10ml of this solution into the other 100ml standard measuring flask. Take in to a titration flask and add 20 ml of dil H_2SO_4 acid to it. Heat the mixture to about 60°C and titrate it against N/20 $KMnO_4$ solution taken in a burette. The end point in appearance of permanent pale pink colour. Repeat the above experiment) with 50.0 gm of 1, 2, 3 and 4 days old guava fruit.

4. Calculation

Calculation of strength of oxalic acid

Equivalent weight of oxalic acid = 63

Normality of Oxalic Acid $= \frac{\text{Weight / liter}}{\text{Equivalent weight}}$

$= \frac{0.7 \times 5}{63}$

Normality of Oxalic acid = 0.06 N

Calculation of strength of $KMnO_4$

Volume of oxalic acid V_1 = 20 ml

Strength of oxalic acid N_1 = 0.061N

Volume of $KMnO_4$ V_2 = 23

Normality of $KMnO_4$ N_2 = ?

$V_1N_1 = V_2N_2$

$N_2 = V_1N_1/V_2$

= 20 x 0.061 / 23

Normality of $KMnO_4$ (N_2) = 0.053N

Calculation of amount of oxalate ions in guava fruit

Weight of guava fruit taken each time = 50 g

Volume of guava extract taken for each titration = 20 ml

Table 3.1

Types of fruit	Burette Reading		Volume of $KMnO_4$ (ml)	Concordant Value (ml)
	Initial	Final		
Fresh fruit	0 0	5.5 5.5	5.5 5.5	5.5
One day old	0 0	7.3 7.3	7.3 7.3	7.3
Two days old	0 0	8.2 8.2	8.2 8.2	8.2
Three days old	0 0	8.9 8.9	8.9 8.9	8.9
Four days old	0 0	9.6 9.6	9.6 9.6	9.6
Five days old	0 0	10.3 10.3	10.3 10.3	10.3

Normality of the $KMnO_4$ solution used for titration=0.053 N

i) For Fresh guava fruit

Volume of $KMnO_4$ Solution V_1 = 5.5 ml

Normality of $KMnO_4$ solution N_1 = 0.053 N

Volume of guava fruit extract V_2 = 20 ml

Normality of the oxalate ions in the guava extract N_2 =?

$V_1N_1 = V_2N_2$

$N_2 = V_1N_1/V_2$

N_2 = 5.5 x0.053/20

= 0.014575 N

Amount of oxalate ions in 1000g fresh guava extract

= $N_{oxalate}$ x 44 x 100/1000 x 1000/50 g/litre

= 0.03084 x 44 x 2

= 1.2826 g/litre

Calculation of amount of oxalate ions in Sapota fruits

Weight of Sapota fruit taken each time = 50 g

Volume of Sapota extract taken for each titration = 10 ml

Table 3.2

Types of fruit	Burette Reading		Volume of KMnO4 (ml)	Concordant Value
	Initial	Final		
Fresh fruit	0 0	9.7 9.7	9.7 9.7	9.7 ml
One day old	0 0	10.2 10.2	10.2 10.2	10.2 ml
Two days old	0 0	11.2 11.2	11.2 11.2	11.2 ml
Three days old	0 0	11.9 11.9	11.9 11.9	11.9 ml
Four days old	0 0	12.7 12.7	12.7 12.7	12.7 ml
Five days old	0 0	13.3 13.3	13.3 13.3	13.3 ml

Normality of the $KMnO_4$ solution used for titration = 0.04746 N

ii) For Fresh sapota fruit

Volume of $KMnO_4$ Solution V_1 = 9.7 ml

Normality of $KMnO_4$ solution N_1 = 0.053 N

Volume of sapota fruit extract V_2 = 20 ml

Normality of the oxalate ions in the sapota extract N_2 = ?

$V_1N_1 = V_2N_2$

$N_2 = V_1N_1/V_2$

N_2 = 9.7 x0.053/20

= 0.025705 N

Equivalent weight of oxalate ion = 44

Amount of oxalate ions in 1000g fresh sapota extract

= $N_{oxalate}$ x 44 x 100/1000 x 1000/50 g/litre

= 0.025705x 44 x 2 g/ litre

= 2.26204 g/litre

5. Result and Discussion

The oxalate content of guava and sapota fruits at different stages of ripening were found out by permanganometric method. The results are given below:

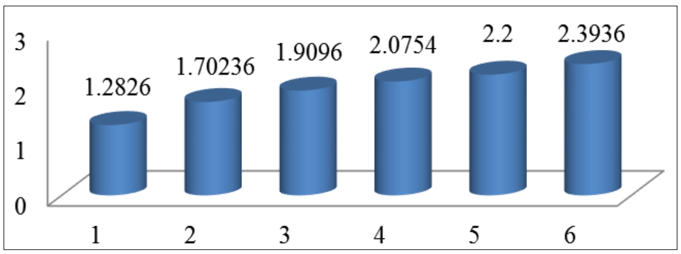
Table 4.1

Sample	Weight of oxalate ion in 50g of guava fruits (g/litr)
Fresh guava	1.2826
First day guava	1.70236
Second day guava	1.9096
Third day guava	2.0754
Fourth day guava	2.2
Fifth day guava	2.3936

Table 4.2

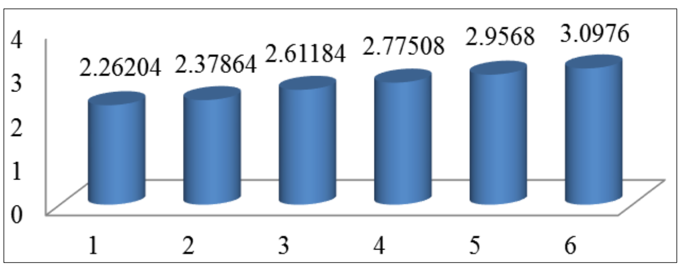
Sample	Weight of oxalate ion in 50g of sapota fruits (g/litre)
Fresh sapota	2.26204
First day sapota	2.37864
Second day sapota	2.61184
Third day sapota	2.77508
Fourth day sapota	2.9568
Fifth day sapota	3.0976

From the above table it was found that the amount of oxalate content varies with ripening of fruits. Among the five days of guava and sapota fruits, fresh fruits had minimum oxalate content. As days went on during ripening the oxalate content increased progressive and had the maximum oxalate content in the fully ripe fruit.



1. Fresh guava 2. First day guava 3. Second day guava
4. Third day guava 5. Fourth day guava 6. Fifth day guava

Fig 4.1: Chart representing the changes in oxalate content of guava fruit during ripening



1. Fresh sapota 2. First day sapota 3. Second day sapota
4. Third day sapota 5. Fourth day sapota 6. Fifth day sapota

Fig 4.2: Chart representing the changes in oxalate content of sapota fruit during ripening

6. Conclusion

This project centered upon estimating the amount of oxalate present in the sapota and guava fruits during ripening. The oxalate content was on the increase in both the fruits and the days passed on, that is as the ripening proceeded. It should be noted that the increase in oxalate content was mere in sapota than in Guava. The presence of oxalate in injurious to health. Oxalate rich foods are usually restricted to some degree, particularly in patients with high urinary oxalate level. Guava and sapota fruit have the highest percentage of vitamin C among citrus fruits. It also contains oxalate amount of which varies with ripening of the fruit. During ripening of guava and sapota fruit; the oxalate content increases progressively and the fully ripe fruit has the maximum oxalate content. Oxalate form an insoluble complex with calcium in the urine, or hyper-oxaluria, is even more important to stone formation than high levels of calcium or hypercalcicuria. Excessive intake of food and drink containing oxalate leads to calcium oxalate stone. Also, excessive intake of vitamin C which metabolized to oxalate may lead to hyper calcicuria and an increase in stone formation. Pain medications can be prescribed for symptom relief. Surgical techniques have also been developed to remove kidney stones. Rather than having to undergo treatment, it is best to avoid kidney stone in the first place. Avoid calcium rich foods and drink more water. Water helps to flush away that form stones in the kidneys.

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ISSN **2321-743X**
International Journal of Research in
Engineering and Bioscience
Volume **3** Issue **5** (Pages 75- 80)
IJREB
Journal home page: www.ijreb.org

ESTMATION OF OXALATE IONS IN SAPOTA, TOMATO, AND GUAVA IN DIFFERENT STAGES OF RIPENING

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ABSTRACT

The work aims to estimate the Oxalate ion in three fruits varies during different stages of ripening. Oxalate is the dianion with the formula C_2H4^{2-}. Many metal ions form insoluble precipitates with oxalate (eg) calcium oxalate, the primary constituent of the most common kind of kidney stones. In the present study the oxalate content was more in riped sapota than in guava and Tomato. This in turn will provide an advice to take medium riped fruits always balancing the taste of the fruit and physiological power of affecting the kidney by Oxalate content.

KEYWORDS: Oxalate ion, Kidneystone, Guava, Tomato, sapota

INTRODUCTION

1.1. Oxalate (IUPAC: Ethanediate)

Oxalate is the dianion with the formula $C_2H_4^{2-}$, also written $(coo)_2^{2-}$ Either name is often used for derivatives, such as salts of oxalic acid, for example sodium oxalate $Na_2C_2O_4$, or dimethyl oxalate $(CH_3)_2C_2O_4$. Oxalate also forms coordination compounds where it is sometimes abbreviated as oxalate.

Many metal ions form insoluble precipitates with oxalate, a prominent example being calcium oxalate, the primary constituent of the most common kind of kidney stones.

Occurance in nature:

Oxalate occurs in many plants, where it is synthesized by the incomplete oxidation of carbohydrate. The root or leaves of Rhubarb and buckwheat are high in oxalic acid. Other edible plants that contain significant concentrations of oxalate include in decreasing order, star fruit (carambola), black pepper, parsely, poppy seed, amaranth, spinach, chard, beets, cocoa, chocolate, most nuts, most berries, fishtail palms, New Zealand spinach (Tetragonia tetragonioides) and beans.

Leaves of tea plants (mellia sinensis) contain among the greatest measured concentrations of oxalic acid relative to other plants.

Physiological effects:

In the body, oxalic acid combines with divalent metallic cations such as calcium (ca^{2+}) and iron (II) (Fe^{2+}) to form crystals of the corresponding oxalates which are then excreted in urine as minute crystals. These oxalates can form larger kidney stones that can obstruct the kidney tubules. An estimated 80% of kidney stones are formed from calcium oxalate. Those kidney disorders, gout, rheumatoid arthritis, or certain forms of chronic vulvar pain (vulvodynia) are typically advised to avoid foods in oxalic acid.

Oxalic acid can also be produced by the metabolism of ethylene glycol ("anti freeze"), glyoxalic acid or ascorbic acid (vitamin C).

Powdered oxalate is used as a pesticide in bee keeping to combact the bee mite.

Some fungi of the genus Aspergillus produce oxalic acid.

Health risk due to oxalate:

Although unusual consumption of oxalates (for example, the grazing of animals on oxalate containing plants such as Bassia hyssopifolia, or human consumption of wood sorrel) may result in kidney disease or even death due to oxalate poisoning.

MATERIALS AND METHODS

METHODS OF PREPARATION OF SOLUTIONS

Preparation of stock solution (0.05 N $KmnO_4$)

Preparation of oxalate solution

50 g of both sapota, tomato, and guava pulp were weighed separately and ground using mortar and pestle. The crushed pulp was transferred to a beaker and 50 ml of dil. H_2SO_4 was added to it. Then the contents were boiled for 10 minutes, cooled and the extract was filtered through a fine cloth. The residue was discarded and the filtrate was transferred into a 100 ml standard flask, 10 ml of this extract was pipette out into 100 ml standard measuring flask. It was washed repeatedly with distilled water and it was transferred into the same flask and made up to mark. The solution was shaken well for uniform mixing and labeled.

ESTIMATION OF FREE OXALATE IONS IN EXTRACT

Standardization of $KMnO_4$

20 ml of 0.05 N standard ferrous ammonium sulphate solution was pipette out into a clean conical flask. Equal volume of dil. H_2SO_4 was added and titrated the solution against $KMnO_4$ taken in the burette. End point is the appearance of permanent pale pink color. The titrations were repeated to get the concordant value. From the titre value, the strength of $KMnO_4$ is calculated.

Standardization of free oxalate ions in the extract

Previously cleaned and rinsed burette was filled with the standard potassium permanganate solution. 10ml of the extract containing oxalate ion was pipette out into a clean conical flask. An equal volume of dilute sulphuric acid was added. The contents of the flask were heated to 70^0C and titrated against potassium permanganate taken in the burette. The appearance of permanent pale pink color indicates the end point. From the titre value strength and the amount of oxalate ions present in the whole of the solution was calculated.

The above experiment was repeated by taking 50 gram of the sapota, tomato, and guava at different stages of ripening (l e. after raw and ripe) each time, making 100 ml of the solution as explained above and titrating against the same normality of $KMnO_4$ solution.

RESULTS AND DISCUSSION

In this project, three types of fruits (Sapota, Tomato, and Guava) were taken to estimate the oxalate ions and how it amount varies during different stages of ripening. The three fruits are the rich source of oxalate. From the titre value, it should be noted that the increase in oxalate content was more in sapota than in guava and tomato.

CALCULATION

Weight of sapota taken =50 gm

Volume of sapota extract taken for titration = 10ml

Extract from sapota	**Burette reading**		**Volume of $KMnO_4$ (ml)**	**Concordant value**
	Initial	**Final**		
Raw Fruit	0	5.2	5.2	5.2
Ripe Fruit	0	7.2	7.2	7.2

Normality of the $KMnO_4$ solution used for titration = 0.1923 N

For raw sapota fruit

Amount of oxalate ions in 1000 g raw sapota extract

$$= N_{oxalate} \text{ X } 44 \text{ X } \frac{100}{1000} \text{ X } \frac{1000}{50} \text{ g/litre}$$

= 0.0529 x 44 x2

= 4.6552 g/litre

For fresh sapota fruit:

Amount of oxalate ions in 1000g of fresh sapota fruit

$$= N_{oxalate} \text{ X } 44 \text{ X } \frac{100}{1000} \text{ X } \frac{1000}{50} \text{ g/litre}$$

= 0.0733x 44 x2

= 6.4504 g/litre

Amount of oxalate ions in tomato fruits:

Volume of tomato extract taken for titration=10 ml

Weight of tomato fruit taken = 50g

Normality of the $KMnO_4$ solution used for titration = 0.1923 N

Extract from tomato	Burette reading		Volume of KMnO4 (ml)	Concordant value
	Initial	Final		
Raw fruit Fresh fruit	0 0	2 3	2 3	2 3

For raw tomato fruit:

Amount of oxalate ions in 1000 g raw tomato extract

$$= N_{oxalate} \times 44 \times \frac{100}{1000} \times \frac{1000}{50} \; g/litre$$

= 0.02038 x 44 x2

=1.7934 *g/litre*

For fresh tomato fruit

Amount of oxalate ions in 1000g fresh tomato extract

$$= N_{oxalate} \times 44 \times \frac{100}{1000} \times \frac{1000}{50} \; g/litre$$

= 0.03057 x 44 x2

=2.6901

Amount of oxalate ions in guava fruit:

Volume of guava extract taken for titration =10 ml

Weight of guava fruit taken = 50g

Normality of the $KMno_4$ solution for titration = 0.1923 N

Extract from guava	Burette reading		Volume of $KMnO_4$ (ml)	Concordant vale
	Initial	Final		
Raw Fruit	0	4.7	4.7	4.7
Ripe Fruit	0	5.3	5.3	5.3

For Raw guava fruit:

Amount of oxalate ions in 1000g raw guava extract

$$= N_{oxalate} X\ 44 \quad X \frac{100}{1000} \quad X \frac{1000}{50} \ g/litre$$

= 0.0478 x 44 x 2

= 4.2064 *g/litre*

For Fresh guava fruit:

Amount of oxalate ions in 1000g fresh guava extract

$$= N_{oxalate} X\ 44 \quad X \frac{100}{1000} \quad X \frac{1000}{50} \ g/litre$$

= 0.1019x 44 x 2

= 8.9672

CONCLUSION

It should be concluded that the increase in oxalate content was more in sapota than in guava and tomato. The presence of oxalate is injurious to health. The oxalate present in the riped fruits. But we should bear in mind the physiological power of oxalate in affecting the kidney based on the above facts, generally speaking and it is also advisable to take medium riped fruits (sapota, tomato, and guava) always balancing the taste of the fruit and physiological power of affecting the kidney by oxalate content.

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