ESTIMATION OF OXALIC ACID IN SOME FRUITS AND VEGETABLES

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INTRODUCTION

Oxalic acid is the simplest dicarboxylic acid and occurs as the dihydrate $C_2H_2O_4 \cdot 2H_2O$. It is a colourless crystalline solid soluble in water. It is a reducing agent and its deprotonated species, oxalate ion ($C_2O_4^{2-}$), is a chelating agent for metal cations[1]. Its main applications include cleaning or bleaching, especially for the removal of rust due to the formation of a stable, water-soluble ferrioxalate ion. Hydrated lanthanide oxalates are formed readily in very strongly acidic solutions in a densely crystalline, easily filtered form, largely free of contamination by non-lanthanide elements. Thermal decomposition of these oxalates gives the oxides, which is the most commonly marketed form of these elements. Oxalic acid is required in our body for the formation of uracil and orotic acid[2].

More than 90 per cent of the oxalic acid consumed is normally excreted through urine. Organic form of oxalic acid, in low concentration, is essential to maintain peristaltic motion in our body. However, when it is processed or cooked, it becomes inorganic form, and may have certain negative effects on the body. Oxalic acid in concentrated form can have harmful effects through contact and ingestion. It is not identified as mutagenic or carcinogenic; there is a possible risk of congenital malformation in the fetus; may be harmful if inhaled, and is extremely destructive to tissue of mucous membranes and upper respiratory tract; harmful if swallowed; and causes burns if absorbed through the skin or is in contact with the eyes. Symptoms and effects include a

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burning sensation, cough, wheezing, laryngitis, shortness of breath, spasm, inflammation and edema of the larynx, inflammation and edema of the bronchi, pneumonia and pulmonary edema. In humans, ingested oxalic acid has an oral LD_{Lo} (lowest published lethal dose) of 600 mg/kg. It has been reported that the lethal oral dose is 15 to 30 grams[3].

ESTIMATION OF OXALIC ACID

Oxalic acid can be estimated by volumetry, colorimetry and chromatography. Volumetric estimation can be done by permanganometry. The oxalate ion is estimated volumetrically by titration with standard $KMnO_4$ solution in acid medium[4].

$$2\ KMnO_4 + 3\ H_2SO_4 + 5\ H_2C_2O_4 \dashrightarrow K_2SO_4 + 2\ MnSO_4 + 10\ CO_2 + 8\ H_2O$$

In the colorimetric method, oxalate is co-precipitated with calcium sulphate and ethanol, reduced to glycolate by zinc and sulphuric acid and measured spectrophotometrically with chromatropic acid[5].

Gas chromatography is a widely used method of oxalic acid estimation. Solid sample is extracted with water (soluble oxalic acid) or 2 N hydrochloric acid (total oxalic acid), at room temperature. An aliquot of sample extracted is evaporated to dryness. The oxalic acid in the residue is methylated with 7% hydrochloric acid-methanol. The reaction mixture is extracted with chloroform and dimethyl oxalate is quantitated by gas chromatography. The recovery of oxalic acid added to liquid samples averaged 100.6, such as recovery from extracts of solid sample were 96.2-99.5 and 97.2-100.1% for water and hydrochloric acid extraction, respectively[5].

DETERMINATION OF OXALIC ACID CONTENT IN FRUITS AND VEGETABLES

Weigh accurately a definite amount of food sample using an electronic balance and grind well using a mortar and pestle. The ground food sample is transferred in to a beaker and add about 50 mL 4N dilute H_2SO_4 to it. The contents are boiled for about 10 minutes. Cooled and filtered in to a 100 mL standard flask. Added distilled water and solution is made up to the mark. The solution was shaken well for uniform concentration.

Pipette out 20 mL of the solution into conical flask. Added 20 mL of dilute H_2SO_4 solution and heated to bearable warm (60-70^oC). The solution is titrated against standard $KMnO_4$ solution taken in the burette untill the appearance of a permanent pale pink

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colour[5]. The titrations are repeated till concordant values are obtained. From the titre value the normality of oxalic acid in the food sample can be calculated.

FRUITS

Grapes

Sapota

Guava

Mosambi

Orange

Mango

Apple

Table 1: Percentage of oxalic acid in fruits

Sl. No.	***Fruit***	***Weight (g)***	***Volume of $KMnO_4$ used (mL)***	***Percentage of oxalic acid***
1	Grapes	9.96	20.2	6.33
2	Sapota	4.92	19.2	12.19
3	Guava	14.6	21.3	4.55
4	Mosambi	10.82	20.3	5.87
5	Orange	9.86	22.3	7.06
6	Mango	23.11	22.0	2.95
7	Apple	10.12	22.0	6.79

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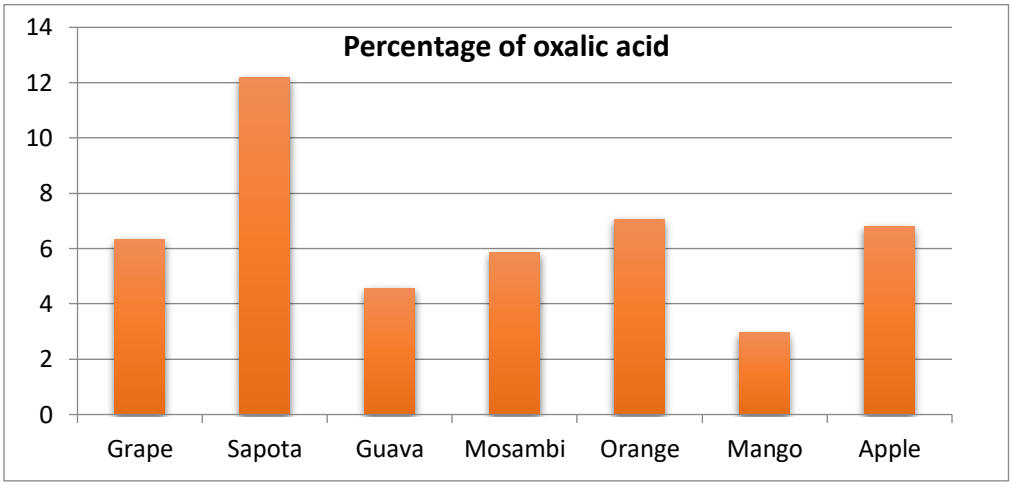

Among the seven fruits studied the oxalic acid content is **highest in Sapota** and **lowest in Mango**. The percentage of oxalic acid in fruits follows the order; **Sapota > Orange > Apple > Grape > Mosambi > Guava > Mango.**

Among the seven fruits studied the oxalic acid content is highest in Sapota and lowest in Mango. The percentage of oxalic acid in fruits follows the order; Sapota > Orange > Apple > Grape > Mosambi > Guava > Mango.

VEGETABLES

Tomato

Cucumber

Green brinjal

Beans

Violet brinjal

Snake gourd

Ash gourd

Ladie’s finger

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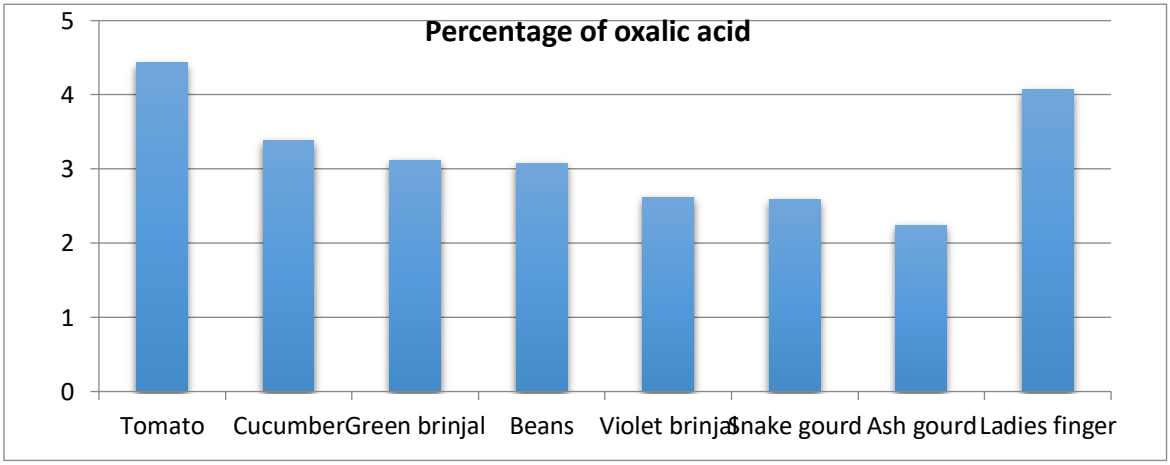
Table 2: Percentage of oxalic acid in fruit vegetables

Sl. No	***Vegetable***	***Weight (g)***	***Volume of $KMnO_4$ used (mL)***	***Percentage of oxalic acid***
1	Tomato	13.84	19.6	4.43
2	Cucumber	21.91	23.8	3.39
3	Green brinjal	20.02	20.0	3.12
4	Beans	25.32	25.0	3.08
5	Violet brinjal	29.05	24.4	2.62
6	Snake gourd	26.53	22.0	2.59
7	Ash gourd	35.37	25.4	2.24
8	Ladie's finger	16.85	22.0	4.07



Among the eight vegetables studied the oxalic acid content is highest in Tomato and lowest in Ash gourd. The percentage of oxalic acid follows the order; Ash gourd < Snake gourd < Violet brinjal < Beans < Green brinjal < Cucumber < Ladie's finger < Tomato.

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