

Determination and Comparison of Ascorbic Acid in Vegetables

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Abstract

Human body requires ascorbic acid in order to form and maintain bones, blood vessels, and skin. The determination and comparison of ascorbic acid/vitamin C present in three different vegetables such as tomato, carrot and cucumber was studied. Determination of ascorbic acid was carried out by iodometric titration. The quantity of ascorbic acid found in tomato juice, carrot juice and cucumber juice are 0.619g/l, 0.4864g/l and 0.3979g/l respectively. The amount of ascorbic acid is more in tomato juice when compared with other vegetable juices.

Key words: Ascorbic acid, Vegetables, Juice, Iodometric Titration, Comparison.

INTRODUCTION:

Vitamin C was discovered in 1912, isolated in 1928, and in 1933, was the first vitamin to be chemically produced. It is on the World Health Organization's list of essential medicines, the safest and most effective medicines in a health system. Vitamin C is available as an inexpensive generic and over-the-counter medication. Vegetables are parts of plants that are consumed by humans or other animals as food. Vegetables can be eaten either raw or cooked and play an important role in human nutrition, being mostly low in fat and carbohydrates, but high in vitamins, minerals and dietary fiber. Many nutritionists encourage people to consume plenty of fruit and vegetables, five or more portions a day often being recommended (Rickman, 2007).

Foods containing vitamin C include citrus fruits, kiwi fruit, broccoli (Wu,1992), Brussels sprouts, raw bell peppers, and strawberries. Plant foods are generally a source of vitamin C, the amount in foods of plant origin depends on the variety of the plant, soil condition, climate where it grew, length of time since it was picked, storage conditions and method of preparation (Gunjan, 2012). This vitamin is the most widely taken nutritional supplement and is available in a variety of forms, including tablets, drink mixes, and capsules. Prolonged storage or cooking may reduce vitamin C content in foods. In this study, the determination of ascorbic acid in vegetables was determined using an iodometric titration.

Significance of ascorbic acid

Vitamin C is an essential nutrient for certain animals including humans. The term vitamin C encompasses several vitamers that have Vitamin C activity in animals. Ascorbate salts such as sodium ascorbate and calcium ascorbate are used in dietary supplements. These release ascorbate upon digestion.

Ascorbate and ascorbic acid are both naturally present in the body, since the forms inter convert according to pH. Oxidized forms of the molecule such as dehydroascorbic acid are converted back to ascorbic acid by reducing agents (Lee, 1976).

Human requires ascorbic acid in order to form and maintain bones, blood vessels, and skin. Ascorbic acid also promotes the healing of cuts, abrasions and wounds, helps fight infections, inhibits conversion of irritants in smog, tobacco smoke, and certain foods into cancer causing substances, appears to lessen the risk of developing high blood pressure and heart disease, helps regulate cholesterol levels, prevents the development of scurvy, appears to lower the risk of developing cataracts, and aids in iron absorption. Ascorbic acid can cause adverse reactions when taken with some drugs.

Deficiency Diseases

The disease scurvy is caused by vitamin C deficiency and can be prevented and treated with vitamin C- containing foods or dietary supplements. Vitamin C supplementation reduces the risk of myocardial-infraction, stroke, cardiovascular mortality, or all- cause mortality. Vitamin C concentration is lower in people with cognitive impairment, including Alzhemiar's disease and dementia, compared to people with normal cognition (Frankee, 2004).

Vegetables for good health

Vegetables are low in fat, salt and sugar. They are a good source of dietary fibre. As part of a well-balanced, regular diet and a healthy, active lifestyle, a high intake of fruit and vegetables can help you to reduce obesity and maintain a healthy weight, lower your cholesterol and blood pressure (Padayatty, 2003). Vegetables contain phytochemicals, or plant chemicals these biologically active substances can help to protect you from some diseases. Scientific research shows that if you regularly eat lots of fruit and vegetables, you have a lower risk of (1) Type 2 diabetes, (2) Stroke, (3) cardiovascular disease- when fruits and vegetables are eaten as food, not taken as supplements, (4) Cancer- some forms of cancer, later in life, (5) High blood pressure (hypertension).

MATERIALS AND METHODS

Chemical required:

Water, ascorbic acid, Iodine, Potassium Iodide, starch.

Materials required:

Carrot juice, Tomato juice, Cucumber juice, Burette, Pipette, Conical flask, Standard Measuring flask (SMF), Bunsen's burner and Muslin cloth.

Vegetable selection

The tomato is the edible berry of the plant *Solanum Lycopersicum*, commonly known as a tomato plant. Numerous varieties of the tomato plant are widely grown in temperate climates across the world, with greenhouses allowing for the production of tomatoes throughout all seasons of the year. Tomato is

consumed in diverse ways, raw or cooked, in many dishes, sauces, salads and drinks. While tomatoes are fruits botanically classified as berries – they are commonly used as a vegetable ingredient or side dish. A tomato is 95% water, contains 4% carbohydrates and less than 1% each of fat and protein (Russell, 1986).

Carrots are root vegetables that have a wealth of antioxidants and offer many health benefits. They are rich in beta- carotene, a compound which body changes into vitamin A, which help keeps your eyes healthy. And beta- carotene helps protect your eyes from the sun and lowers your chances of cataracts and other eye problems. They can lower your risk of cancer: Antioxidants have been proven to fight off harmful free radicals in your body, and that can make you less likely to have cancer. The two main types of antioxidants in carrots are carotenoids and anthocyanins. Carotenoids give carrots their orange and yellow colors, while anthocyanins are responsible for red and purple colouring. They boost your immune system: The vitamin C in carrots helps your body build antibodies that defend your immune system. Vitamin C also helps your body take in and use iron and prevent infections. The fiber in carrots can help keep blood sugar levels under control.

Cucumbers are 98% water. Cucumber Juice is derived from cucumbers produced by squeezing or pressing it. It is used in beverages such as cocktails and Bloody Mary, dishes such as cucumber soup, and in dips and salad dressings, such as green goddess dressing. Cucumber has significant amounts of potassium and is high vitamin A. It also contains significant amounts of silicon. It also contains sterol. Cucumber juice is used as an ingredient in cosmetics, soaps, shampoos, and lotions, and perfumes. It was used in Russian traditional medicine to aid in the treatment of respiratory tract inflammation and to reduce lingering cough. In other traditions it was used to soothe heartburn and reduce acid in the stomach. For skin, it has been used to soo the burns and rashes. Cucumber juice has been described as a repellent against wood lice and fish moths.

Preparation of Iodine Solution:

Weight 0.254g of solid iodine and pour in a dry beaker. Add 4g of solid potassium iodide.

Then add distilled water to dissolve it. Transfer this solution to a clean 100ml volumetric flask and prepare required quantity of distilled water that was added to make 100ml of iodine solution. In this way another 100ml of iodine solution also prepared. This solution has a molarity of 0.01M.

Preparation of Starch Indicator

To prepare a 0.05% starch indicator solution 10.25g of starch was stabilized in a 100ml beaker and 50ml of distilled water was added. The solution was heated with stirring at 79°C for 5 min. The resultant solution was allowed to cool at room temperature.

Vitamin C Standard Solution:

0.176g of ascorbic acid is weighed accurately and dissolved in a 100ml SMF. This solution has a molarity of 0.01M.

Sample Preparation:

Tomato juice, Carrot juice and Cucumber juice were prepared from each of its vegetable samples, 100g of each sample was cut into small pieces, blend together with 50ml of distilled water using an electronic blender and then filtered. The filtrate was transferred to a 100ml SMF and the flask was filled up to the mark with distilled water.

The solution of the juice is titrated against iodine solution. The process is stopped at the point, when the colour of juice solution in conical flask changes to blue colour. Three concordant readings are monitor.

Titration Calculation:

Calculated the ml of titrant used for each flask. Take the measurements obtained and average them.

$$\text{Average volume} = \frac{\text{total volume}}{\text{number of trials}}$$

Determine how much titrant was required for the standard. It was needed an average of 10.0ml of iodine solution to react 0.176 g of vitamin C, then we can determine how much vitamin C was in a sample. For example if me needed 6.00ml to react the juice. $10.00\text{ml iodine solution}/0.176\text{g vitamin C} = 6.00 \text{ ml iodine solution}/\text{xml vitamin C}$

Keep in mind the volume of the sample so we can make other calculations such as grams per litre. For a 25 ml juice sample, for example $0.15\text{g}/25 \text{ ml}=0.15\text{g}/0.025\text{l}=6.00\text{g/l}$ of vitamin C in that sample

RESULTS AND DISCUSSION

The amount of ascorbic acid present in vegetable juices are determined using the titration method is given below

Standardisation of iodine solution

S. No.	Volume of ascorbic acid (ml)	Burette reading (ml)		Volume of iodine solution (ml)
		Initial	Final	
1	20	0	19.9	19.9
2	20	0	19.9	19.9

Concordant value: 19.9 ml

Indicator: starch

Titration for Juice Samples

Sl. No	Samples	Volume of sample	Titre value	
			Initial	Final
1	Carrot juice	20	0	1.4
2	Tomato juice	20	0	1.1
3	Cucumber juice	20	0	0.9

Indicator: Starch

Burette solution: Iodine solution

Pipette solution: Vegetable juices

By using the above readings the amount of ascorbic acid present in the vegetable juice can be calculated.

Amount of ascorbic acid present in tomato juice:

19.9 ml of iodine solution/0.176 g of vitamin C = 1.4 ml of iodine solution/x ml vitamin C

$$19.9/0.176 = 1.4/x$$

$$x * 19.9 = 1.4 * 0.176$$

$$x = (1.4 * 0.176) / 19.9$$

$$x = 0.01238g$$

$$\begin{aligned} 0.01238g/20 \text{ ml} &= 0.01238g/0.020ml \\ &= 0.619g/l \end{aligned}$$

Amount of ascorbic acid present in carrot juice:

19.9 ml of iodine solution/0.176 g of vitamin C = 1.1 ml of iodine solution/x ml vitamin C

$$19.9/0.176 = 1.1/x$$

$$x * 19.9 = 1.1 * 0.176$$

$$x = (1.1 * 0.176) / 19.9$$

$$x = 0.009728g$$

$$\begin{aligned} 0.009728g/20 \text{ ml} &= 0.009728g/0.020ml \\ &= 0.4864g/l \end{aligned}$$

Amount of ascorbic acid present in cucumber juice:

19.9 ml of iodine solution/0.176 g of vitamin C = 0.9 ml of iodine solution/x ml vitamin C

$$19.9/0.176 = 0.9/x$$

$$x * 19.9 = 0.9 * 0.176$$

$$x = (0.9 * 0.176) / 19.9$$

$$x = 0.007959g$$

$$\begin{aligned} 0.007959g/20 \text{ ml} &= 0.007959g/0.020ml \\ &= 0.39795g/l \end{aligned}$$

The amount of ascorbic acid present in the vegetable juices can be given below:

Sl. No.	Vegetable sample	Amount of ascorbic acid
1	Tomato juice	0.01238g
2	Carrot juice	0.009728g
3	Cucumber juice	0.00795g

The amount of ascorbic acid is 0.01238g/20ml in tomato juice, 0.009728g/20ml in carrot juice and 0.00795g/20ml in cucumber juice.

When we compare the above vegetable juices the amount of ascorbic acid in tomato is more when compared with other vegetable juices. Intake of ascorbic acid rich vegetables makes the human system with high immune power. Intake of rich vitamin C food leads to avoid the risk of scurvy. It is known as an antioxidant. Ascorbic acid is easily oxidized. This may also reduces the risk of cardiovascular problems, improves brain function.

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