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Determination of the Potential Role and Health benefit of the Concentration of Vitamin c in some Fruit Samples

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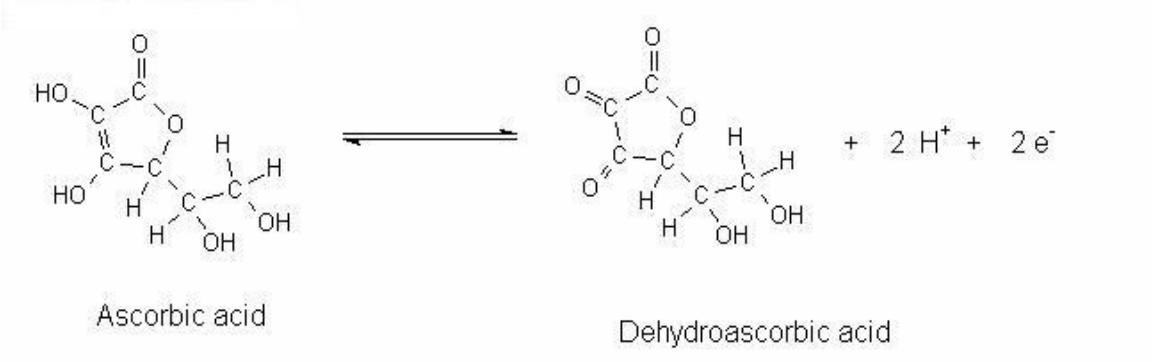
Abstract
As a result of the rapid increase in stroke, lack of immune system functioning well, wrinkles on skin and so many more, this experiment was carried out to show the importance and benefits of vitamin c in the human body. Vitamin c content in four different fruit samples was determined by qualitative analysis (iodometric titration). Results obtained show variation in vitamin c content in different fruit samples and the value ranges from 0.0290 to 0.0054 showing higher amount of vitamin c in orange fruits compared to the other fruits.
Other scientist that carried out similar experiment with different methods have shown varying results: in some cases orange fruits/juices have higher vitamin c content; some experiments were carried out on ripe and unripe fruits to determine the concentration of vitamin c in them. However, this experiment shows higher amount of vitamin c content in orange, lemon, pineapple and mango respectively.
Key words: Ascorbic acid, iodometric titration, lemon, mango, orange, pineapple.

1. Introduction

Vitamins are a collection of molecular compounds that are important nutrients in many multi-cellular organisms, and humans in particular. L-Ascorbic acid was first isolated as a pure substance by Albert Azent-Gyorgi and Charles Kingin 1928 [Paulling, 1970] , an anti-oxidant and free radical scavenger, is found generally in fruit and vegetables such as citrus fruits (lemons, orange, tangerines, etc.), melons, tomatoes, peppers, broccoli, green leafy vegetables such as spinach, potatoes and turnips, its quantitative determination is essentially important in the production of wine, beer, milk, fruit juices and soft drinks, where it can be a quality indicator [Gerrior & Zizza,1994].

Given the essential role played by Vitamin C in the human diet, necessary for growth and repair of tissues in all parts of human body. It is also necessary to form collagen an important skin proteins, scar tissue, tendons, ligaments, and blood vessels. Vitamin C is essential for the curing of wounds, and for the darning and maintenance of cartilage, bones and teeth [McEvoy, 1993]. Since vitamin C is easily oxidized, storage and cooking in air leads to the dynamic oxidation of vitamin C by oxygen in the atmosphere. Also, ascorbic acid is water-soluble vitamin means that a significant amount of vitamin C present in a food can be lost by boiling and then removing the cooking water [McEvoy, 1993]. The formula for ascorbic acid is $C_6H_8O_6$. It occurs as a white or slightly yellow crystal or powder with a slight acidic test. Ascorbic Acid is easily soluble in water; frugally soluble in alcohol; insoluble in ether, chloroform, and benzene [Moffat, 1986]. The structures for the reduced (ascorbic acid) form and for the oxidized form (dehydroascorbic acid) are shown below:



Vitamin C deficiency leads to scurvy, a disease described by weakness, small hemorrhages throughout the body that cause gums and skin to bleed, and weakening of the teeth. Vitamin C cannot synthesize through body cells, nor does it store it. It is consequently important to include plenty of vitamin C-containing foods in daily diet. Vitamin C toxicity is very rare, because the body cannot store the vitamin, though, amounts more than 2000 mg/day are not recommended because such high doses can lead to stomach upset and diarrhea. The minimum daily requirement is 30 mg. Well-balanced diets provide appropriate amounts of the vitamin as measured by the Recommended Daily Allowance (RDA) of about 75 mg per day for adults (aged 15 or older), less for children, and more for pregnant and lactating women. The National Academy of Sciences recommends the consumption of 60 mg of ascorbic acid per day. The Federal Food and Drug Administration have approved the recommended dietary allowance (RDA) of 60 mg/day. A very slight daily intake of vitamin C (10-15 mg/day for an adult) is required to avoid deficiency and stave off scurvy. However, there has been, and continues to be, vivacious debate on what the optimum daily intake of vitamin C is. Some have argued that 200 mg/day is an optimal daily intake for adult humans. Others have suggested 1-2 g/day is best, despite this, numerous studies show that the blood is saturated with vitamin C at 100 mg/day, and any excess is excreted in the urine [RDA,1995; RDA,1987; Browne.,1993; FAO/WHO,2002; Levine *et al.,*1999;Levine *et al.,*1995;Teoh ,1975]

Human and other prelates have lost the ability to synthesize vitamin C as a result of a mutation in the gene coding for L-gulonolactoneoxidase, an enzyme required for the biosynthesis of vitamin C via the glucuronic acid pathway (Woodall & Ames, 1997). Thus, vitamin C must be gotten through the diet. Vitamin C is the major water – soluble antioxidant within the body (Sies & Wilhlm, 1995; Levine et al., 1986 and Levine et al., 1995). It lowers blood pressure and cholesterol level (Rath, 1993). Not only does a vitamin C intake obviously reduce the severity of a cold, it also effectively prevents secondary viral or bacterial problems. Numerous analysis have shown that an adequate intake of vitamin C is effective in lowering the risk of developing breast cancer, cervix, colon, rectum, lung, mouth, prostate and stomach(Levine et al.,1996; Block, 1992; Feri 1994; Block, 1991 and Jacobs, 1993). This vitamin is particularly plentiful in fresh fruit and fruit juices, in specific citrus fruit, and vegetables (Bendich, 1997).

This study seeks to determine the concentration of Vitamin C in some dehydrated juice which is highly desirable in diet because of their beneficial effects on human health. The concentration and stability of this vitamin can be influenced by various factors such as genotype differences, climatic conditions, soil state, maturity at harvest and harvesting methods (Podsedek, 2007; Lee and Kader, 2000). The higher the intensity of light during the growing

season, the greater is vitamin C content in plant tissue (Lee and Kader, 2000). The advances in analytical techniques have made possible the identification and understanding the functions of Ascorbic acid.

Vitamin C is a water-soluble vitamin that plays a role in sustaining the health of the body's connective tissues as well as acting as an antioxidant.
A severe vitamin C deficiency will result from the breakdown of collagen.
Scurvy is rarely seen today, as only a very small amount of vitamin C is needed to prevent it.
But even mild vitamin C deficiency symptoms include easy bruising, bleeding gums, slow wound healing, dry terrible hair, nosebleeds, and dry red spots on the skin, where blood has leaked out of the capillaries.
Benefits of consuming vitamin C rich foods include:

- Promotes healthy glowing skin and collagen formation
- Improves mineral absorption
- Fights free radical damage

Top health benefits of vitamin c

- Healthy Immune Function

Vitamin C stimulates the production of white blood cells and helps these immune cells to function properly. Vitamin C, since it is an antioxidant, helps protect white blood cells from oxidative damage and therefore keeps them functioning properly.
Although it is commonly believed that Vitamin C will boost the immune system to help fight off colds, the studies regarding its ability to prevent or reduce illness have been inconclusive.

- Skin health

Higher vitamin C intakes have been connected to a decrease in the appearance of wrinkles and skin dryness. Vitamin c is a powerful antioxidant, which can help reduce the effect oxidative damage caused by pollution, stress or poor diet.
Free radicals formed by oxidative damage speed up the aging process, but adequate intakes of vitamin C may help slow it down, especially on the appearance of the skin.

- Reduced Risk of Stroke

The American Journal of Clinical Nutrition featured a study that found those with high levels of vitamin C in their blood had almost a 50% decreased risk of stroke.
The accurate reason is still unclear and researchers are unspecified if it is just the high consumption of fruit and vegetables from the diet that lowers the risk of stroke.

2. Previous analysis of vitamin c

Various methods were employed for vitamin c determination in juices; such method includes spectrophotometric, coloumetric, turbidimetric etc.

Angelo et al, (1972) reported the concentration of vitamin c in an orange juice samples to be 0.326-0.506%'

Dmitnenko et al, (1998) determined ascorbic acid in juice samples by spectrophotometric method which based on the reduction of molybdisilliec acid (H4SiMo12O40) polyurethane foam tablets containing 9mmol/g (H4SiMo12040) were prepared.
The tablets were dried between two sheets of filter paper. The ascorbic acid assay was performed by immersing foam of tablet in 250ml ascorbic acid solution at PH5 for one hour with shaking.
The PH was then adjusted to two with 0.1M HCl and the mixture was shaken for further 15 minutes.
The polyurethane foam tablet was removed and dried between two sheets of filter paper.
The diffuse reflectance spectra were recorded for 300-800nm and the signal at 720nm was taken as analytical parameter.
The reported result was 0.30-2.40mg/ml ascorbic acid. The recoveries of 0.35% of ascorbic acid from orange juice and 0.67% ascorbic acid from no alcoholic drink were quantitative and RSD were <6%.

Addo, (1983) determined ascorbic acid contents of oranges to be 0.32-0.57%, pineapples 0.25-0.26% and mangoes 0.24-0.26% which are fruit commonly consumed in Northern Nigeria.

Shaw P.E. (1982) determined ascorbic acid content of some tropical fruit juice on high performance liquid chromatography. The ascorbic acid content of mango was 2.9mg/100g and mango molmade 7.3mg/100g.

Albach (1983) determined vitamin c concentration in whole orange puree. The whole orange puree prepared by standardized procedure contains total vitamin c value of 44-75mg/100g. Purees made from smaller fruit had higher vitamin c concentration than those made from large fruit.
Thomas, determined vitamin c content and distribute in mangoes during ripening.

The result shows that mango ripened at ambient temperature 29-33˚c or at 20˚c, pulp from ripe fruit has ascorbic acid 12 to 117mg/100g and peel had 85 to 519mg/100g values differed among the four varieties and were greater for fruit ripened at 20˚c unripe fruit had greater vitamin c content than ripe fruit.

3. Materials And Methods

Qualitative analysis of fruit samples

Preparing solutions

1% Starch Indicator Solution was prepared by adding 0.50g soluble starch to 50ml distilled water and boiled, mix well and allow cooling before use.

Iodine Solution was prepared by mixing 5.00g potassium iodide (KI) and 0.3g potassium iodate (KIO3) were dissolved into a 500ml-graduated cylinder with 200ml of distilled water. 30ml of 3M sulfuric acid was added into the cylinder and diluted to a final volume of 500ml with distilled water. The solution was transferred to a 600ml beaker as iodine solution.

Vitamin C Standard Solution was prepared by dissolving 0.3g ascorbic acid in 100ml-distilled water and diluted to 250ml with distilled water in a volumetric flask. The flask was labeled as vitamin c standard solution. This procedure was repeated triplicates.

Standardizing solutions

250ml of vitamin c standard solution was added to an Erlenmeyer flask. 10 drops of 1% starch solution were added to the flask and then titrated against iodine solution until blue-black color was observed (the end point). The initial and final volume of iodine solution was recorded.
The titrations were repeated twice.

Procedure

100g of already peeled fruit sample was weighed, blended and filtered with a sieve to obtain the juice.
The juice was then transferred to 100ml volumetric flask and diluted to the mark with distilled water.
25ml of the diluted juice was pipetted into a conical flask and 1ml of starch indicator was added.
The solution was titrated against iodine solution until a persisted blue-black coloration appeared.
The experiment was carried out in triplicate and the average titer value was determined.

4. Results and discussion

Vitamin C content of hydrated juice solids was determined by titration with iodine, which acts as oxidizing agent. Oxidation takes place during addition of titrant to the sample solution.
The iodine essentially oxides 'enediol' group in the ascorbic acid are an alphadicarbonyl group in the dehydroascorbic acid. The reaction involves two-electron change.

4:1
Table 1:
Titre value for orange

S/NO	FINAL TITRE VALUE (ml)
1	4.2
2	4.1
3	4.2
AVERAGE	4.16

Table 2:
Titre value for lemon

S/NO	FINAL TITRE VALUE (ml)
1	2.80
2	2.80
3	2.80
AVERAGE	2.80

Table 3:
Titre value for pineapple

S/NO	FINAL TITRE VALUE
1	1.6
2	1.7
3	1.7
AVERAGE	1.67

Table 4:
Titre value for mango

S/NO	FINAL TITRE VALUE (ml)
1	0.8
2	0.8
3	0.6
AVERAGE	0.77

Table 5:
STANDARD TITRE VALUE

S/NO	FINAL TITRE VALUE (ml)
1	42.8
2	43.0
3	42.9
AVERAGE	42.9

- Vitamin c content (mg/100g) in orange

= 0.3 Of SAA x Average titre value/Average titre value of SAA
= 0.3 x 4.16 /42.9
= 0.0290

- Vitamin c content (mg/100g) in lemon

= 0.3 of SAA x Average titre value/ Average titre value of SAA
= 0.3 x 2.8/42.9
= 0.0195

- Vitamin c content in pineapple

= 0.3 0f SAA x Average titre value/ Average titre value of SAA
= 0.3 x 1.67/ 42.9
= 0.0117

- Vitamin c content in mango

= 0.3 0f SAA x Average titre value/ Average titre value of SAA
= 0.3 x 0.77/42.9
= 0.00538

5. CONCLUSION

Table 6:

S/NO	SAMPLE	MEAN TITRE VALUE	VITAMIN C CONTENT
1	Mango	0.77	0.00538
2	Pineapple	1.67	0.0117
3	Lemon	2.80	0.0195
4	Orange	4.16	0.0290

The primary source of vitamin c in nature is carbohydrate (glucose) or other simple precursor e.g. D-glucuronic acid. The synthesized vitamin c is stored in the plant tissues and is only lost or destroyed on cooking or on exposure to high temperature.

From the table above, it shows that vitamin c content is high in orange and low in mango. The vitamin is high in orange because orange contains highest amount of enzymes responsible for hydrolysis of UDP-D-glucuronic acid to D-glucuronic acid which is a precursor in the biosynthesis of the vitamin c and the percentage is low in mango because mango contains less amount of enzymes responsible for hydrolysis of UDP-D glucuronic acid to D-glucuronic acid.

PROBLEM SOLVED

This experiment has shown that if someone is suffering from scurvy or deficiency of vitamin c such as cold, dry splitting hair, stroke, unhealthy immune system, wrinkles on the skin and so much more, it is advised that the person should consume a lot of orange fruits rather than mango.

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