WORLD JOURNAL OF PHARMACEUTICAL RESEARCH
SJIF Impact Factor 8.074
Volume 7, Issue 5, 956-965. Research Article ISSN 2277– 7105

# STABILITY OF VITAMIN C (ASCORBIC ACID) IN FRESH JUICE OF STRAWBERRY

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Article Received on
06 January 2018,

Revised on 27 Jan. 2018,
Accepted on 16 Feb. 2018,

DOI: 10.20959/wjpr20185-11237

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## ABSTRACT

Strawberries are a good source of nutritional compounds and rich in Vitamin C (Ascorbic acid). Strawberry juice is easily damaged in transit due to temperature fluctuations and in the presence of oxygen in an oxidation reaction that may significantly reduce shelf life. In this way, ten days stability study of freshly prepared juice of strawberry was conducted and the amount of ascorbic acid degraded in juice kept at room temperature as well as refrigerator temperature 2-8ºC, Were estimated by iodine titration method, end point is bright red color of juice to dark brown color. In ten days stability studies the Vitamin C (Ascorbic acid) content reduced in both freshly prepared juices kept at room temperature and in refrigerator. Furthermore, it showed a fast decrease of shelf life for samples exposed to room temperature in comparison with samples kept at refrigerator temperature (2-8ºC). At room temperature, the vitamin C content degradation rate ranges from 65.6 mg/L to 43.2 mg/L. At refrigeration condition, the vitamin C content ranges from 65.6 mg/L to 48 mg/L respectively.

**KEYWORDS:** Vitamin C (Ascorbic acid), Strawberry juice, Iodine solution, Starch solution temperature.

## 1. INTRODUCTION

### 1.1 Nutritional values of strawberry[1]

The garden strawberry (or simply strawberry; *Fragaria* × *ananassa*) is known as the strawberries. It is consumed in large quantities, either fresh or in such prepared foods as preserves, juice, pies, ice creams, milkshakes, and chocolates. Artificial strawberry

flavorings and aromas are also widely used in many products like lip gloss, candy, hand sanitizers, perfume, and many others. Pelargonidin-3-glucoside is the major anthocyanin in strawberries andcyanidin-3-glucoside is found in smaller proportions. These anthocyanins are responsible for bright red color of strawberry. Nutritional values of strawberry are mentioned in table no.1.

**Table No.1 Nutritional values of strawberry.**

| S. No. | Nutritional value per 100 g (3.5 oz) | |
|---|---|---|
| 1 | Energy | 136 kJ (33 kcal) |
| 2 | Carbohydrates | 7.68 g |
| 3 | Sugars | 4.89 g |
| 4 | Dietary fiber | 2 g |
| 5 | Fat | 0.3 g |
| 6 | Protein | 0.67 g |
| 7 | Thiamine (B1) | 0.024 mg |
| 8 | Riboflavin (B2) | 0.022 mg |
| 9 | Niacin (B3) | 0.386 mg |
| 10 | Pantothenic acid (B5) | 0.125 mg |
| 11 | Vitamin B6 | 0.047 mg |
| 12 | Folate (B9) | 24 µg |
| 13 | Choline | 5.7 mg |
| 14 | Vitamin C | 58.8 mg |
| 15 | Vitamin E | 0.29 mg |
| 16 | Vitamin K | 2.2 µg |
| 17 | Calcium | 16 mg |
| 18 | Iron | 0.41 mg |
| 19 | Magnesium | 13 mg |
| 20 | Manganese | 0.386 mg |
| 21 | Phosphorus | 24 mg |
| 22 | Potassium | 154 mg |
| 23 | Sodium | 1 mg |
| 24 | Zinc | 0.14 mg |
| 25 | Water | 90.95 g |
| 26 | Fluoride | 4.4 µg |

Red colour of strawberry easily changes upon storage and is replaced by a dull brownish color (Gössinger et al., 2009).[7] This is the result of the simultaneous degradation of natural redanthocyanin pigments to colourless compounds (Kirca & Cemeroğlu, 2003; Mercadante and Bobbio, 2008)[8] and the formation of brown pigments due to enzymatic and/or non-enzymatic reactions (Bharate and Bharate, 2014; Garzón and Wrolstad, 2002; Gössinger et al., 2009).[9]

### 1.2 Role of Vitamin C (Ascorbic acid)[2]

Vitamin C (Ascorbic acid), also known as L-ascorbic acid, is a water-soluble vitamin that is naturally present in some foods, added to others, and available as a dietary supplement. Vitamin C (Ascorbic acid) is an essential nutrient for certain animals including humans. Vitamin C is a cofactor in at least eight enzymatic reactions in animals (and humans) important in many essential functions, including wound healing. In humans, vitamin C deficiency compromises collagen synthesis, contributing to the more severe symptoms of scurvy. More generally, the biochemical role of vitamin C is to act as an antioxidant, a reducing agent, donating electrons to various enzymatic and non-enzymatic reactions. Doing so converts vitamin C to an oxidized state - either as semidehydroascorbic acid or dehydroascorbic acid. These compounds can be restored to a reduced state byglutathione and NADPH-dependent enzymatic mechanisms.

In plants, vitamin C is a substrate for ascorbate peroxidase. This enzyme utilizes ascorbate to neutralize toxic hydrogen peroxide ($H_2O_2$) by converting it to water ($H_2O$).

### 1.3 Recommended Intakes[3]

Intake recommendations for Vitamin C (Ascorbic acid) and other nutrients are provided in the Dietary Reference Intakes (DRIs) developed by the Food and Nutrition Board (FNB) at the Institute of Medicine (IOM) of the National Academies (formerly National Academy of Sciences).

**Table no.2 Recommended dietary allowances of Vitamin C (Ascorbic acid).**

| Age | Male | Female | Pregnancy | Lactation |
|---|---|---|---|---|
| 0-6 months | 40 mg* | 40 mg* | | |
| 7-12 months | 50 mg* | 50 mg* | | |
| 1-3 years | 15 mg | 15 mg | | |
| 4-8 years | 25 mg | 25 mg | | |
| 9-13 years | 45 mg | 45 mg | | |
| 14-18 years | 75 mg | 65 mg | 80 mg | 115 mg |
| 19+ years | 90 mg | 75 mg | 85 mg | 120 mg |

Smokers Individuals who smoke require 35 mg/day more vitamin C than nonsmokers.

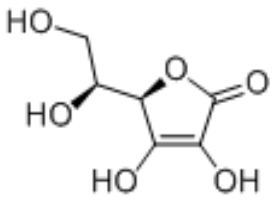
* Adequate Intake (AI)

### 1.4. Properties of Vitamin C (Ascorbic acid)[4,5]

**Description**

It is a six carbon compound related to glucose. It is found naturally in citrus fruits and many Vegetables. Ascorbic acid is an essential nutrient in human diets and necessary to maintain connective tissue and bone. Its biologically active form, vitamin C, functions as a reducing agent and coenzyme in several metabolic pathways. Vitamin C is considered an antioxidant.

**Structure**




**Chemical Formula:** C6H8O6

**Molecular Weight:** 176 gm/mol

**IUPAC Name:** (5R)-5-[(1S)-1, 2-dihydroxyethyl]-3, 4-dihydroxy-2,5-dihydrofuran-2-one.

**Appearance:** white to slightly yellowish crystalline powder, practically odorless, with Pleasant, sharp, strong acidic taste.

**Boiling point:** 553 °C

**Melting point:** 190-194 °C (dec.)

**Storage temperature:** 0-6°C

**Solubility: Water Solubility :**333 g/L (20 ºC)

Insoluble in ether, chloroform, benzene, petroleum ether, oils, fats, fat solvents

**pH:** 1.0 - 2.5 (25℃, 176g/L in water

**Stability:** Stable. May be weakly light or air sensitive. Incompatible with oxidizing agents, alkalis, iron, copper.

## 2. MATERIALS AND METHOD

### 2.1 Preparation of juice

Take strawberry fruits then Wash strawberries and remove stem and cut into small pieces. Transfer these strawberry pieces to a blender, Blend until smooth puree. Add water and blend again for a minute. Place a fine mesh over a large container and pour prepared puree over it to remove the foam results during blending.

### 2.2 Juice storage

Freshly prepared juice of strawberry was divided into two equal portions and kept in room temperature and and refrigerator (2-8 °C).

### 2.3 Vitamin C (Ascorbic acid) determination[6]

**Method**: Iodine titration method.

#### 2.3.1Preparation of reagents

**a) 0.5% Starch Indicator Solution**

1. Add approximately 0.5 g soluble starch to 50 mL near-boiling deionised water.
2. Mix well and allow to cool before use.

**b) Iodine Solution**

1. Dissolve 5.00 g potassium iodide (KI) and 0.268 g potassium iodate ($KIO_3$) in 200 mL of distilled water.
2. Add 30 mL of 3 M sulfuric acid.
3. Pour this solution into a 500 mL graduated cylinder and dilute it to a final volume of 500 mL with distilled water.
4. Mix the solution.
5. Transfer the solution to a 600 mL beaker. Label the beaker as your iodine solution.

**c) Vitamin C Standard Solution**

1. Weigh out accurately about 0.250 g vitamin C (ascorbic acid) into a 250 mL volumetric flask. Add about 100 mL distilled water and swirl to dissolve.
2. Add distilled water to make up to the mark. Label the flask as your vitamin C standard solution.

#### 2.3.2 Standardizing the IodineSolution

1. Using a pipette, add 25.00 mL aliquot of vitamin C standard solution to a 125 mL conical flask. Note: this would contain 0.0250 g of vitamin C.
2. Add 10 drops of 0.5% starch solution.
3. Rinse your burette with a small volume of the iodine solution and then fill it. Record the initial volume.
4. Titrate the solution until the endpoint is reached. This will be when you see the first sign of blue color that persists after 20 seconds of swirling the solution.

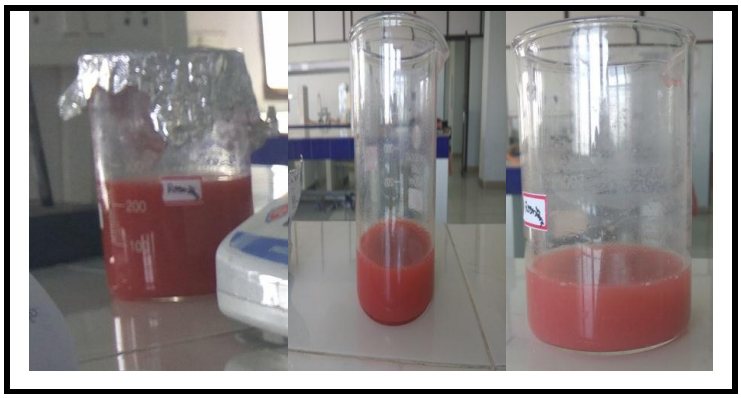
5. Record the final volume of iodine solution. The volume that was required is the starting volume minus the final volume.
6. Repeat the titration at least twice more. The results should agree within 0.1 mL.

### 2.3.3 Titrating Juice Samples

1. Add 25.00 mL of juice sample to a 250 mL conical flask.
   Titrate against iodine solution in the burette until the endpoint is reached. It is when you get a color that persists longer than 20 seconds.
2. Repeat the titration until you have at least three titers that agree to within 0.1 mL. Note: if the titers are too big (>25 mL) consider cutting back the aliquot (sample) of Strawberry juice to 10 mL or less.

## 3. RESULTS

Ten days degradation study of Vitamin C (Ascorbic acid) at room temperature and refrigerator (2-8°C) was conducted and amount of Vitamin C (Ascorbic acid) was determined by Iodine titration method and results were mentioned in the table no.3 and 4.



**"Fig No. I" Left side freshly prepared juice, middle juice after ten days in refrigerator (2-8°C), Right side juice after ten days at room temperature (25°C).**

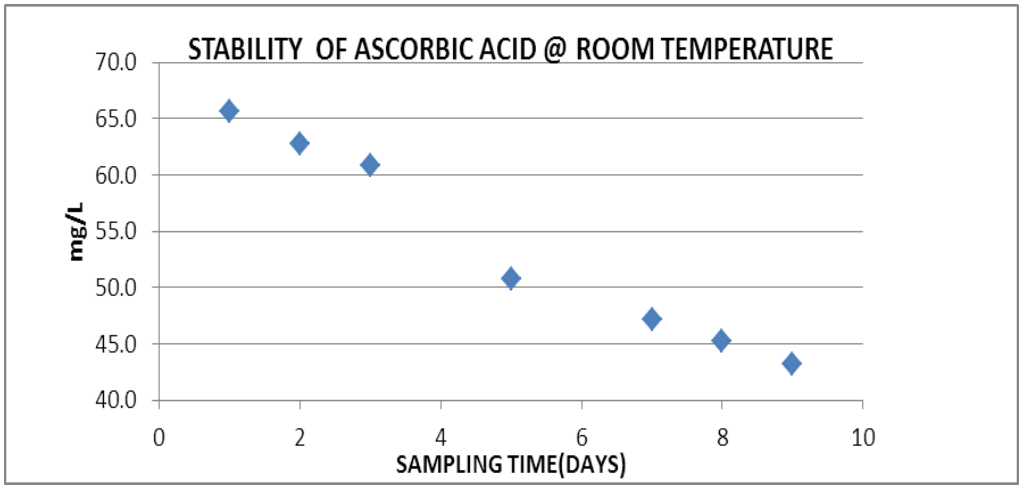

**"Fig No. II" Left side End point (blue) of Vitamin C standard solution, Right side end point (dark brown) of juice.**

**"Table No.3" Degradation of Vitamin C (Ascorbic acid) at room temperature (25°C) and color change status of freshly prepared strawberry juice.**

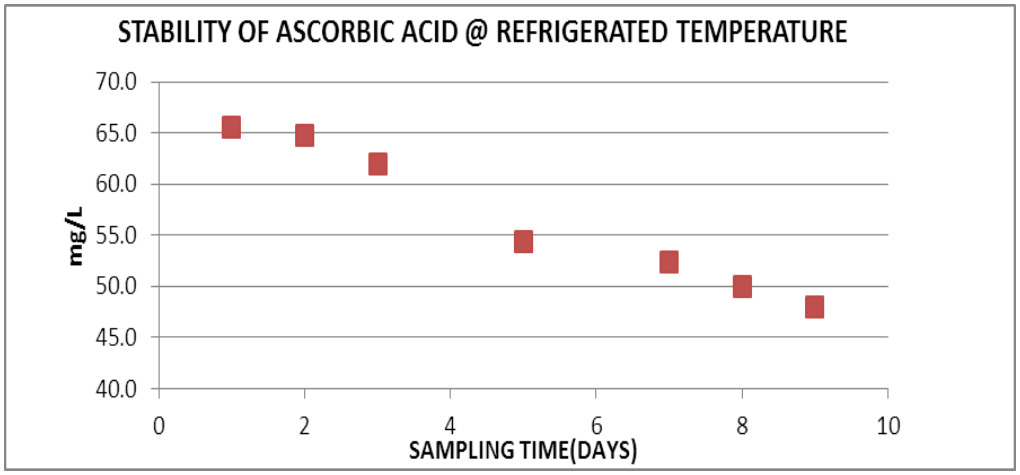
| S. No | Temperature | Sampling(Days) | Status of Juice | End point | Amount of vitamin c (mg/ L) |
|---|---|---|---|---|---|
| 1 | Room temperature (25°C) | 1st day | Bright red color and fresh | Dark brown color | 65.6 |
| 2 | | 2nd day | Bright red color and fresh | Dark brown color | 62.8 |
| 3 | | 3rd day | Bright red color and very slight change in aroma | Dark brown color | 60.8 |
| 4 | | 5th day | Red color and aroma changed | Dark brown color | 50.8 |
| 5 | | 7th day | Color of juice turned to light and decomposed | Dark brown color | 47.2 |
| 6 | | 8th day | Color of juice reduced and decomposed | Dark brown color | 45.2 |
| 7 | | 9th day | Turned to dull red color and completely decomposed | Dark brown color | 43.2 |

**"Table No.4" Degradation of Vitamin C (Ascorbic acid) at (2-8°C) temperature and color change status of freshly prepared strawberry juice.**

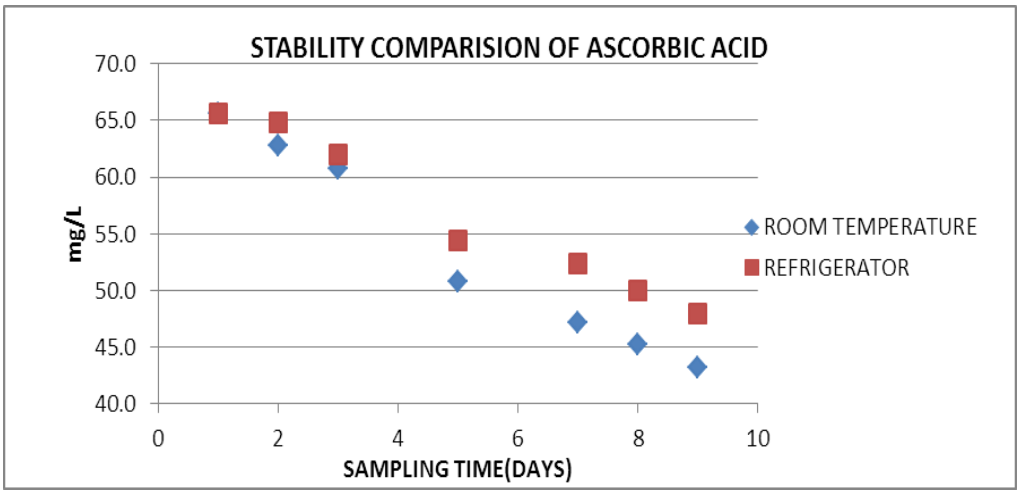
| S. No | Temperature | Sampling(days) | Status of juice | End point | Amount of vitamin c (mg/L) |
|---|---|---|---|---|---|
| 1 | Refrigerator (2-8°C) | 1st day | Bright red color and fresh | Dark brown color | 65.6 |
| 2 | | 2nd day | Bright red color and fresh | Dark brown color | 64.8 |
| 3 | | 3rd day | Bright red color and fresh | Dark brown color | 62.0 |
| 4 | | 5th day | Bright red color and fresh | Dark brown color | 54.4 |
| 5 | | 7th day | Bright red color and fresh | Dark brown color | 52.4 |
| 6 | | 8th day | Bright red color and fresh | Dark brown color | 50 |
| 7 | | 9th day | Bright red color and fresh | Dark brown color | 48 |




**"Fig No.1" Degradation rate of Vitamin C (Ascorbic acid) at room temperature (25°C).**




**"Fig No.2" Degradation rate of Vitamin C (Ascorbic acid) at refrigerator (2-8°C) temperature.**




**"Fig No.3" Comparison of Degradation rate of Vitamin C (Ascorbic acid) at room temperature (25°C) and refrigerator (0-6°C) temperature.**

## 4. SUMMARY

On first day the vitamin C contents of fresh juices (kept at room temperature (25°C) and refrigerator (2-8°C) temperature) were found to be 65.6 mg/L. During the period of ten days, the vitamin C content was found reduced significantly at both room temperature condition and at refrigeration temperature conditions. At room temperature, the vitamin C content ranges from 65.6 mg/L to 43.2 mg/L. At refrigeration condition, the vitamin C content ranges from 65.6 mg/ L to 48 mg/L respectively "Fig No.3". Usually the end point of vitamin C standard solution is blue color by iodine titration method. But due to the color interference in this experiment gotten end point is dark brown color "Figure No. I". after 3 days of storage the color of the juice kept at room temperature gets started changing the color to red color finally to light red color after ten days.

## 5. CONCLUSION

The results obtained after an accurate analysis and precise measurement shows that the vitamin C contents reduced in both freshly prepared juices kept at room temperature and at refrigerated temperature may be due to the absence of preservatives. By observing degradation values mentioned in the table, refrigeration storage is more preferable due to the slow degradation rate as compared to Room storage as per analytical data mentioned in fig no. vitamin C. Degradation is more rapid in the juice kept at room temperature when compared to juice kept at refrigerator temperature and more over the juice kept in refrigerator is fresh and fresh aroma of strawberry was also retained. The juice kept at room temperature got decomposed (fried egg smell) after two days, after ten days completely turned to light red color. Color difference showed in "Figure No. I".

## 6. ACKNOWLEDGEMENT

We here by acknowledge the moral and technical support of Dr. N. Siva Subramanian, Principal, Dr. G. Naveen Kumar Reddy, HOD Department of Pharmaceutical Analysis, and Management, Gland Institute of Pharmaceutical Sciences.

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