Research Paper

Volume : 3 | Issue : 11 | November 2014 • ISSN No 2277 - 8179

# Determination of Vitamin C and its Heat Stability in Local Fruit Juices Available in Shillong City of Meghalaya State, India

Chemistry

**KEYWORDS :** Vitamin C, juices, temperature

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## ABSTRACT

*Vitamin C is a very good source of biological antioxidants and is freely available from fruits and vegetables. Deficiency of vitamin C leads to scurvy in humans. Vitamin C is destroyed by many cooking processes and on exposure to air. The objective of this study is to determine the amount of vitamin C in seven local madefruit juices available in Shillong city. The effect of heat on percentage reduction of vitamin C was also investigated in these juices. The study showed that orange juice contained more vitamin C in the fresh state while prunus juice had the least vitamin C content at 200C. A reduction in the concentration of vitamin C on heating from 300C to 700C was also observed. Therefore fruit juices should not be stored at higher temperature conditions to prevent the loss of vitamin C.*

**Introduction:**

Regular consumption of fruits and vegetables is associated with reduced risk of several types of diseases and promote a healthy life for human beings. Fruits contain sugars, ascorbic acid, phenolic compounds, minerals which are indispensable for the growth and healthy development of humans. Vitamin C also known as ascorbic acid is a water soluble vitamin which is freely available from fruits and vegetables. Uncooked vegetables and fruits are especially rich in vitamin C [1]. It is required in our daily diet for the growth and development of healthy teeth, bones and gums. It is also important for the synthesis and maintenance of protein collagen. Vitamin C increases iron absorption [2] and may reduce the risk of cancer and other diseases.Regular intake of vitamin C may be helpful to smokers as they are more likely to suffer from oxidative stress and cell damage that can deplete vitamin C. Many studies support that consuming at least 500mg a day of vitamin C can increase the amount blood vessels relax, or dilate, in a process known as vasodilation. This process is thought to help lower blood pressure, reducing risk of heart attack and other cardiovascular diseases[3].

Exposure to heat, light, and air quickly destroys vitamin C. The stability of vitamin C decreases with increase of temperature and pH. [4]. It is also easily oxidized by certain compounds such as oxygen in the air. The chemical instability of vitamin C acid is due to the fact that it is a strong reducing agent and can be deactivated by a wide range of oxidizing agents. For example, the oxidation of vitamin C by atmospheric oxygen in opened citrus juices slowly reduces the vitamin C concentration in these juices when the juices are stored in open containers [5]. Thermal treatments can cause destruction of natural antioxidants present in foods [6]. The recommended daily allowance (RDA) for adult men is 90 mg and for adult women is 75 mg [7]. Vitamin C is not stable to heat, so cooking fruits and vegetables destroys much of their vitamin C content. This suggests that humans actually need more vitamin C than the 75mg to 90mg a day. Humans are among the few mammals that cannot synthesize vitamin C in their bodies and therefore consumption of fruits is one way to obtain this important nutrient. The objective of the study was to determine the concentration of vitamin C by iodometric titration and the effect of heat on percentage reduction of vitamin C in locally available fruit juices. Redox titration is preferred to an acid base titration because some species present in the juice can act as acids and only a few of them interfere with the oxidation of ascorbic acid by iodine.

**Materials and methods:**

Sample collection and preparation: Seven local made fresh fruit juices were purchased from the Department of Agriculture in Shillong city of Meghalaya. The undiluted samples were filtered using cheese cloth to remove any pulp before analysis and vitamin C concentration of the undiluted samples was determined immediately to counteract its instability.

Vitamin C content was determined in all the samples by Oxidation reduction method described by Helmenstine (2008) [8].

**Preparation of Reagents**

**Iodine solution**: 5g of potassium iodide 3(KI) and 0.268g of potassium iodate ($KIO_3$) dissolved in 200ml distilled water followed by addition of 30ml of 3M sulphuric acid. The solution was mixed thoroughly and is then diluted with distilled water up to 500ml in a volumetric flask.

**Vitamin C standard solution**: Ascorbic acid (0.250g) was dissolved in 100ml distilled water and then diluted to 250ml with distilled water in a volumetric flask.

**Starch indicator solution**: 0.50g soluble starch is dissolved in 50ml near boiling water.

All reagents used in the analysis were of analytical grade.

**Vitamin C determination:** Vitamin C standard solution (25ml) was taken in 100ml conical flask and 10 drops of starch solution was added. This was then titrated with iodine solution until the blue color which is the end point persists for 20 seconds was observed. In the same way 25ml of the different undiluted fruit juices were titrated. The initial and final volume of iodine solution was recorded. All titrations were done in triplicates.

Vitamin C contents of seven fresh juices were determined immediately at room temperature ($20^0$C) at the beginning of the experiment and then all the samples were heated at varying temperatureof $30^0$C, $50^0$C and $70^0$C for 10mins each.

**Results and Discussion:**

The main advantages of the iodometric titration method are its simplicity, easily available reagents of low cost and speed of the reaction of iodine with vitamin C. Vitamin C is an essential dietary micronutrient which has a beneficial role in health promoting effects. It is highly sensitive to oxidation and can be easily destroyed on heating and storage at higher temperatures.

Thermal treatment is believed to cause degradation in natural antioxidants in foods.Vitamin C decreases gradually during storage especially at temperature above 0$^0$C [9]. The results of the study are presented in Table 1 and 2. As seen from Table 1 vitamin C concentration at 20$^0$C is more in orange juice and the lowest concentration was found in prunus juice. The percentage reduction of vitamin C at different temperature is shown in Table 2. The results showed that there is a degradation of vitamin C concentration on heating from 30$^0$C to 70$^0$C. A reduction from 13.59% to 79.49% was observed in the case of orange juice. It has also been reported[10] that the higher the temperature, the greater the loss of vitamin C in fruits and vegetables. The effect of heating in Table 2 showed that the loss of vitamin C is different from one sample to the other. The highest loss of vitamin C was seen in pineapple juice with a reduction of 65.62% at 30$^0$C to 91.34% at 70$^0$C. Processing conditions such as temperature, pH and moisture content and food preparation stepslike cutting, macerating, washing etc. are known to affect nutrient retention during processingof food [11]. The reasons for losses in the content of the vitamin C are the solubility in water, thermal destruction and enzymatic oxidation during the technological process [12].

**Table1: Concentration of vitamin C in g/100ml at different temperatures.**

| Juices | 20$^0$C | 30$^0$C | 50$^0$C | 70$^0$C |
|---|---|---|---|---|
| Orange | 0.868 | 0.750 | 0.500 | 0.178 |
| Myrica | 0.694 | 0.607 | 0.500 | 0.357 |
| Carambola | 0.560 | 0.500 | 0.464 | 0.178 |
| Litchi | 0.381 | 0.286 | 0.178 | 0.072 |
| Pineapple | 0.416 | 0.143 | 0.107 | 0.036 |
| Strawberry | 0.174 | 0.107 | 0.089 | - |
| Prunus | 0.104 | 0.072 | 0.036 | 0.018 |

**Table 2: Percentage reduction of vitamin C at different temperatures.**

| Juices | 20$^0$C | 30$^0$C | 50$^0$C | 70$^0$C |
|---|---|---|---|---|
| Orange | 0.868 | 13.59 | 42.39 | 79.49 |
| Myrica | 0.694 | 12.53 | 27.95 | 48.55 |
| Carambola | 0.560 | 10.71 | 17.14 | 68.21 |
| Litchi | 0.381 | 24.93 | 53.28 | 81.10 |
| Pineapple | 0.416 | 65.62 | 74.27 | 91.34 |
| Strawberry | 0.174 | 38.50 | 48.8 | - |
| Prunus | 0.104 | 30.76 | 65.38 | 82.69 |

**Fig 1: Concentration of vitamin C with temperature.**

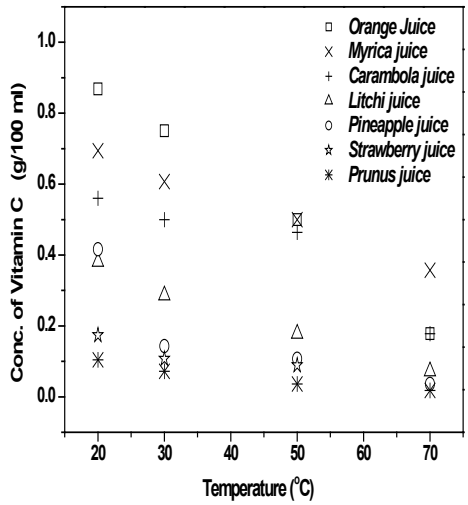
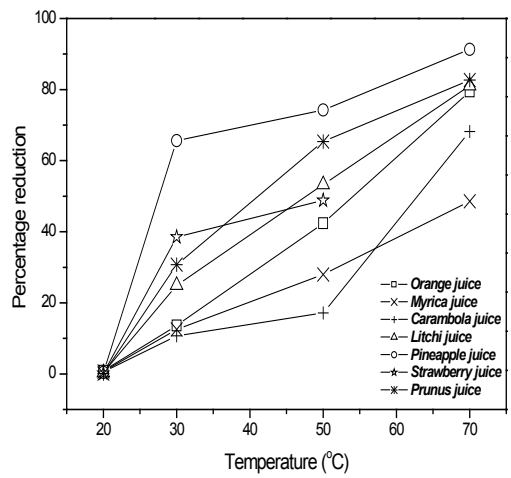



**Fig 2: Percentage reduction of vitamin C with temperature.**




**Conclusion:**

This study revealed that the effect of heat at different temperatures has resulted in the degradation of vitamin C. As temperature increases, the amount of vitamin C that is lost also increases which in turn leaves a smaller amount of it to be consumed. Therefore it is to be noted that consumption of fresh fruits is needed so as to acquire an essential amount of vitamin C which is an important nutrient for maintaining a healthy life. Moreover storage of fruits and juices at higher temperature should be avoided as this leads to degradation of vitamin C.

**Acknowledgement:**

The authors are grateful to the principal of Lady Keane College for providing financial assistance in carrying out the project and also to the head of the department of chemistry for allowing us to use the laboratory for the smooth conduct of the project.

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