1. Introduction

Ascorbic acid, also known as vitamin C, is water soluble, six carbon compounds which occur in both reduced as well as oxidized from in nature (Potter & Hotkiss, 1995). In 1932, nutrition scientists documented that the dangerous disease scurvy can be prevented from citrus fruits. The chemical ascorbic acid in citrus fruits was discovered by Albert Szent-Györgyi and was awarded Nobel Prize in 1937. The efficient use of fats, carbohydrates, and proteins is facilitated by the vitamin C. It is a powerful antioxidant, controls infections and play important role in stress managements (Carr & Frei, 1999; Hwang, 1999; Izuagie & Izuagie, 2007). It has been well established that fruits are the rich source of vitamin C. Review literature show that ascorbic acid reduces the cancer risk, maintain vitamin E resource and increases the iron absorption (Sardi, 2000). The role of ascorbic acid is well known for the repair of every body processes (Carr, Barret & Bruhn, 2007). Interactions with other vitamins, play an important role as the excess of other vitamins become less toxic in presence of vitamin C (Levine et al., 1999; Andrei et al., 2008). The excess dose of vitamin C prevents the common cold and reduces the harshness of its indications. Ascorbic acid enters or leaves the cells in the natural dehydroascorbic acid from except in the eye balls and renal tubular cells (Pant, 1973). The vitamin C is well known for its use in human nourishment. The biochemical function of ascorbic acid is still not known. There is increasing experimental evidence for a specific role of ascorbic acid in collagen synthesis (Gugton, 1980). Vitamin C is readily soluble in water and is thus readily absorbed from the small intestine. Then, it passes directly into the blood to the liver and from there to the rest of the body (Harris, 1987). Vitamin C is strongly affected by heat, light, air, and strong alkali but quite stable in acidic medium. Most of the pat of vitamin C is lost due to heat treatment like blenching, cooking, boiling, cooking under pressure and sterilization of foods (Njoku, Ayuk & Okoye, 2011). Hence, vitamin C becomes deficient or not available in foods to meet the requirements of the body. Seeing the problem, present investigations have been undertaken to study loss /retention of this vitamin on heating the some of the selected fruits/ fruit juices to varying degree. From the results obtained, a suitable method of heat processing of individual fruits/ fruit juice can be recommended for better retention of the vitamins (Tannenbaum, Young, Archer, 1985; Isselbacher, 1980).

2. Materials and methods


B) Instruments - Various instruments used are :
i. Yarco Serological water bath, model no: 45/413, manufactured by Yarco scientific Industries, Delhi-6

ii. Heating plate (1000 watt, cat X 10 968), Gupta scientific Industries, Ambala Cantt, India.

iii. Bajaj super mix rp-15

iv. Juice Extractor

In this research work, continuous spiral press type extractor was used. The extractor made up of a long spiral screw, compresses the fruit against a tapered screen of a fine lattice which has 25 holes per linear inch. The diameter of each hole being of 20/1000 of 2.5 cm. The screen passes the fruit juice whereas the skin and seeds are ousted at the lower end of the mesh. The extractor was wrought at the speed of 250 RPM (revolutions per minute). At such speed of extractor, the possibility of incorporation of air into the juice is very slight (NIIR board of consultants and engineers, 2016). The rumpled fruits, which are nourished to the screw with a hopper at the upper end, are exposed to a jet of steam to avoid oxidation and obliteration of vitamins in the extract (Saddapa, 1996).

Chemicals

In this work, the juice of fresh fruit was extracted (super flame) and analyzed for its ascorbic acid 2,6-dichlorophenol-indophenol (LR), Metaphosphoric acid, sodium bicarbonate (LR grade), Ascorbic acid (AR grade).

Materials

Fruit and vegetables are important sources of ascorbic acid. The most agreeable chemical methods of assessment are founded on the reduction of 2,6-dichlorophenol by ascorbic acid and those grounded on the reaction of the dehydrating ascorbic acid with 2,4-dinitrophenylhydrazine. 2,6-dichlorophenol-indophenol visual-titration method was adopted. The dye, which is blue in alkaline solution and red in acid solution, is reduced by ascorbic acid to a colorless form. The reaction is measurable and almost specific for ascorbic acid in solutions in the pH range of 1.0 - 3.5.

Reagents

1) 3% Metaphosphoric Acid (HPO₃): The sticks or pellets of HPO₃ were dissolved in distilled water to prepare the 3% metaphosphoric acid solution.

2) Ascorbic Acid Standard Solution: 100 mg of L-ascorbic acid was dissolved into 3% HPO₃ solution to make up to 100 ml solution. Dilute the solution by 10 times using with 3% HPO₃ (1 ml = 0.1 mg of ascorbic acid)

3) Dye Solution: The 50 mg of the sodium salt of 2,6-dichloro-phenol-indophenol was dissolved in roughly 150 ml distilled water having 42 mg of sodium bicarbonate. Cooled and diluted through glass - distilled water to 200 ml. The solution was stored in a refrigerator and standardized every day.

Procedure

Standardization of Dye

The standard ascorbic acid solution (5 ml) and HPO₃ solution (5 ml) were mixed in equal proportion. This solution was filled in a micro burette along with dye. Titrate with the dye solution to a pink colour, which should persevere for 15 sec. The dye factor, i.e. mg of ascorbic acid per ml of the dye was determined using the formula:

\[ \text{Dye factor} = \frac{0.5}{\text{Titre}} \]

Preparation of Sample

Fruit Juices: 10 to 20 ml of samples were taken and 3% HPO₃ was added to make it to 100 ml. This solution was filtered and centrifuged at 250 RPM.

Solid or Semi-Solid Food: 10g of the sample was taken and mixed with 3% HPO₃ to make up to 100 ml. The solution was filtered and centrifuged at 250 RPM.

Assay of Extract

An aliquot (2-10 ml) of the HPO₃ excerpt of the specimen was taken and titrated with the standard dye to a pink endpoint. The solution was persevered for at least 15 seconds. The titer was titrated rapidly and made an initial determination. In the subsequent fortitude, most of the dye required was added and then accurately titrated. The aliquot of the sample taken was such that the titer did not surpass 3 to 5 ml.
Table 1: Effect of heating of *Citrus limon* at different temperature for different periods on the loss/retention of ascorbic acid.

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<th>Temperature (°C)</th>
<th>Time of heating (min)</th>
<th>Dye 2,6-dichlorophenol (ml)</th>
<th>Ascorbic acid (mg/100ml)</th>
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**Figure 1:** Retention of ascorbic acid during heating of lemon juice at different temperature

interference by following the formaldehyde condensation procedure given below.

To 10 ml of the filtrate in a test tube, add 1 ml of 40% formaldehyde and 0.1 ml of HCl, keep for 10 min and titrate as before.

**Calculation**

Ascorbic acid content of the sample was calculated using following formula:

\[
W(V) = \frac{Titer \times Volume \text{ aliquot} \times wt (volume)}{100}
\]

Where W(V) represents the weight or volume of ascorbic acid per 100g or 100 ml, Volume, is the total volume of the solution made up, Wt(vol), is the weight or volume of the sample taken for determination.

3. Results and discussion

Fruits and vegetables contain vitamin C (ascorbic acid) in varying quantity but fruit contains more vitamin C than the vegetables. Out of all the fruits, some fruit *Citrus Limon, Ananas Cosmosus, Psidium Guajana, Vitis Vinfera* like and other are rich in vitamin C. This vitamin is very sensitive to processing conditions compared to other vitamins. Therefore, vitamin C gets very easily lost during heating, boiling or other heat processing of fruits/juices. Because of this, it is very difficult to prevent or minimize the loss of this vitamin during heat processing of fruits or its juices. Due to this

**Elimination of Interference Due to Sulphur Dioxide**

Sulfur dioxide, when present in the sample, reduces the indophenol dye and thus interferes with the ascorbic acid analysis. If the sample contains SO₂, eliminate the
problem, present investigation has been undertaken to study loss/retention of vitamin C during the heat processing of some fruit juices. Experiments have been performed in triplicate and average values have been reported.

Table 2: Effect of heating of *Ananas cosmosus* juice at different temperature for different periods on the loss/retention of ascorbic acid.

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<th>Time of heating (min)</th>
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Figure 2: retention of ascorbic acid during heating of pineapple juice at different temperature

3.1. Effect of heat on ascorbic acid of *Citrus Limon*

In the first experiment, *Citrus Limon* was heated to 60°C, 70°C, 80°C, 90°C and 100°C for various time durations 15, 30, 45, 60, 75, 90, & 105 minutes in constant thermal water bath. The loss of vitamin C was determined and the results have been presented in table 1. The trend of the loss of vitamin C during the heating process has been shown in the (Figure-1). From the data and figure, it is clear that the loss of vitamin C is less at a lower temperature. With the increase of heating time, the increase in the loss of vitamin C was observed. The maximum loss of vitamin C has been established in the first 15 minute of heating at a different temperature. After 15 minutes, the rate of loss of vitamin C becomes lesser (Figure 1). This could be due to the presence of surface oxygen of the air and dissolved oxygen in the juice, which makes oxidation loss of ascorbic acid in the initial stage of heating. But in the later stage of heating, steaming, the atmosphere over the surface of juice and absence of dissolved oxygen reduce the loss of ascorbic acid

3.2. Effect of heat on Ascorbic acid of *Ananas Cosmosus*

Similar to above experiment, juice of *Ananas cosmosus* was prepared and heated to 60°C, 70°C, 80°C, 90°C, and 100°C for diverse time durations viz. 15, 30, 45, 60, 75, 90, & 105 minutes in constant thermal water bath. The
loss of vitamin C was determined and the results have been presented in table

Table 3: Effect of heating of *Psidium guajava* juice at different temperature for different period on the loss/retention of ascorbic acid.

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Figure 3: Retention of ascorbic acid during heating of guava juice at different temperature

2. The trend of the loss of vitamin C during the heating process has been shown in the (Figure-2). From the data and figure, it is clear that the loss of vitamin C is less at a lower temperature. As the time of heating is increased, the increase in the loss of vitamin C was observed. The maximum loss of vitamin C has been found in the first 15 minutes of heating at a various temperature, then the further rate of loss of vitamin C become lesser (Figure-2). This could be due to the presence of surface oxygen of the air and dissolved oxygen in the juice which makes oxidation loss of ascorbic acid in the initial stage of heating. But in the later stage of heating, steaming, the atmosphere over the surface of juice and absence of dissolved oxygen reduce the loss of ascorbic acid. As compared to other fruits, loss of ascorbic acid has been found the maximum in apple because the slope is too steep in the latter part of the heating (Figure-2).

3.3. Effect of heat on the ascorbic acid of *Psidium guajava*

As before, *Psidium guajava* fruit juice sample was prepared and juice was heated to 60°C, 70°C, 80°C, 90°C and 100°C for different time durations viz. 15, 30, 45, 60, 75, 90 & 105 minutes in constant temperature water bath. The loss of vitamin C was determined and the results have been presented in table 3. The trend of the loss of vitamin C during the heating process has
been shown in the (Figure-3). From the data and figure, it is clear that the loss of vitamin C is less at a lower temperature. As the time of heating is increased,

Table 4: Effect of heating of grapes (Vitis vinifera) juice at different temperature for different periods on the loss/retention of ascorbic acid.

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Figure 4: Retention of ascorbic acid during heating of grapes juice at different temperature.

oxidation loss of ascorbic acid in the initial stage of heating. But in the later stage of heating, steaming, the atmosphere over the surface of juice and absence of dissolved oxygen reduce the loss of ascorbic acid.

3.4. Effect of heat on ascorbic acid of Vitis Vinifera Juice

Vitis Vinifera juice was heated to 60°C, 70°C, 80°C, 90°C and 100°C for various time durations viz. 15, 30, 45, 60, 75, 90,& 105 minutes in constant temperature water bath. The loss of vitamin C was determined and the results have been presented in table 4. The trend of the loss of vitamin C during the heating process has been shown in the (Figure-4). From the data and figure, it is clear that the loss of vitamin C is less at a lower temperature. As the time of heating is increased, the loss of vitamin C increases. The maximum loss of vitamin C has been found in the first 15 minutes of heating at a different temperature, then the further rate of loss of vitamin C become lesser (Figure-3). This could be due to the presence of surface oxygen of the air and dissolved oxygen in the juice which makes oxidation loss of ascorbic acid in the initial stage of heating. But in the later stage of heating, steaming, the atmosphere...
over the surface of juice and absence of dissolved oxygen reduce the loss of ascorbic acid.

4. Conclusion

Ascorbic acid, also known as vitamin C is essential for growth and maintenance of the human body. It is necessary for the normal formation of the protein collagen, which is an important constituent of skin and connective tissue. The deficiency of vitamin C causes well-known disease “Scurvy”. Vitamin C is present in all citrus fruits e.g. *Citrus Limon*, *Ananas Cosmosus*, *Psidium guajava*, *Vitis Vinifera* and other fruits and vegetables. The vitamin C is very sensitive to heat, light, air and strong alkali. Most of the part of vitamin C is lost during heat treatment (processing) like blanching, boiling, cooking, cooking under pressure and sterilization of foods. The juices of *Citrus Limon*, *Ananas Cosmosus*, *Psidium Guajana*, *Vitis Vinifera* were heated to 60°C, 70°C, 80°C, 90°C, and 100°C for different time durations viz. 15, 30, 45, 60, 75, 90, & 105 minutes in constant temperature bath. The loss of vitamin C is less at a lower temperature. The loss of vitamin C is increased with the heating time. The maximum loss of vitamin C has been found in the first 15 minutes of heating at a different temperature, then the further rate of loss of vitamin C become lesser. The rate of loss of vitamin C is larger in the case of grapes juice in comparison to lemon, pineapple and guava juices. Due to the presence surface oxygen of the air and dissolved oxygen in the juice makes oxidation loss of ascorbic acid in the initial stage of heating. The heat processing of juice in the absence of atmospheric air can prevent the loss of ascorbic acid to some extent.

7. References


NIIR Board of Consultants & Engineers. (2016). The complete technology book on processing, dehydration, canning, preservation of fruits and vegetables (pp-304). Delhi: NIIR project consultancy services, Kamla Nagar.


Sardi, B. (2000). Is high-dose vitamin C risky?
