Storage stability of ascorbic acid enriched fresh whey based amla beverage stored at room and refrigerated conditions

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Abstract  The whey based amla beverage was formulated by adding whey and amla extract at 1:1 (v/v basis). The blend was formulated to contain 10 percent citric acid (w/v of amla extract) and sugar at 40 percent level (w/ v of whey based amla beverage). The influence of storage condition on the ascorbic acid content of whey based amla beverage stored in the presence and absence of light was quantified by 2, 6-dichloro indophenols fibrimetric method. The whey based amla beverage was noted to be acceptable by the consumers till the 10 days of storage at refrigeration temperature and 3 days of storage at room temperature. The influence of light on ascorbic acid (mg/100ml) in whey based amla beverage stored refrigeration and room temperature was noted as 250.4±0.35 on 1st day; 218.3±0.53 and 147.5±0.62 on 4th day; 187.1±0.81 and 103.5±0.74 on 7th day; and 143.7±0.47 and 84.6±0.62 on 10th day respectively. The influence of darkness on ascorbic acid (mg/100ml) retention in whey based amla beverage stored refrigeration and room temperature was noted as 250.4±0.35 on 1st day; 232.6±0.52 and 173.6±0.69 on 4th day; 221.8±0.47 and 139.2±0.57 on 7th day; and 209.3±0.61 and 117.3±0.64 on 10th day respectively. From the observations it was noted that decline in ascorbic acid content was evidenced as the days of storage extends in all whey based amla beverage samples stored under light and dark conditions at room and refrigerated conditions. Rapid decrease in ascorbic acid content was observed in whey based amla beverage stored under light at room temperature than the beverage stored under darkness at refrigerated temperature.

Keywords : Amla, whey beverage, ascorbic acid, storage stability, shelf life

Introduction

The conversion of whey into beverage is one of the most attractive avenues for utilizing whey for human consumption. Owing to unique nutritional properties, whey can be modified into delicious and acceptable forms such as whey drinks by addition of fruit juices to mask its unacceptable taste. Whey beverages are rich in water soluble B-complex vitamins and are a poor source of Vitamin C (ascorbic acid).

Indian gooseberry is one of the richest sources of natural ascorbic acid or vitamin C, the ascorbic acid in the fruit is considered highly stable, apparently protected by tannins which can retard oxidation reaction.

The ascorbic acid content of fresh amla fruit can range up to 650mg/ 100g which is found to be the highest among all fruits. Ascorbic acid is natural antioxidant, free radical scavenger and chelating agent present in bountiful quantity in amla.

The amla fruit is known to contain 89 to 94 percent pulp, 0.8 to 2 percent fiber, 10 to 14 percent total soluble solids (TSS), 1.4 to 2.4 percent acidity, 700 to 900 mg vitamin C per 100g pulp, 2.4 to 3.1 percent pectin and 2 to 3 percent of phenolic compounds as per the observation made by Singh et al., (1993).

Many literature evidences have forecasted the sensitivity of ascorbic acid to processing and storage. Osganian, (2003) stated that Vitamin C is the most easily destroyed vitamin. It is destroyed by oxygen, (above 70°C) and it leaks out into the cooking water because of its water soluble nature. While Nagy and Smoot, (1977) stated that the stability of ascorbic acid decreases with increase in temperature, pH, handling, processing and storage.
From the above context, in the current study, the influence of temperature and light on ascorbic acid content of whey based amla beverage has been investigated.

**Materials and Methods**

Pasteurized double toned milk (Raj Brand), citrate salt (lime soda) was purchased from Jayanthi stores, Dindigul while fresh amla fruits and sugar was purchased from Kannan Departmental stores, Dindigul.

Preparation of whey

Whey was prepared by addition of sodium citrate salt at 0.2 percentage level to milk heated at 80°C for 10 min and subsequently cooled to 72°C. Whey was separated immediately and drained by using muslin cloth and stored at refrigerated condition for further use.

Preparation of amla juice extract

Fresh amla was washed properly in tap water and allowed to drain. The fruit was cut into small pieces and dipped in water to avoid browning reactions. The fruits were then ground finely by adding portable water at v/w basis. The amla extract was collected hygienically and then filtered to remove the suspended solids. To the amla extract 10 percentage citric acid salt was added at w/v basis. The prepared extract was stored at refrigerated condition till it is used. The citric acid salt was added to arrest the enzymatic browning reaction.

**Preparation of whey based amla beverage**

The whey based amla beverage was prepared by blending of whey and amla extract in 1:1 (v/v basis) proportion shown in flow chart. The fresh beverage was filled in previously sterilized glass bottles (200ml) leaving 2.5cm head space and sealed airtight by crown corking. The beverage was stored at room and refrigerated condition. The TSS (Brix) of the prepared whey based amla beverage was 33.5±0.19. The storage studies were carried out on bottled whey based amla beverage stored under light and dark conditions at regular intervals of 3 and 10 days for beverage stored at room and refrigeration conditions respectively.

Quantification of ascorbic acid content

The ascorbic acid (Vitamin C) content in the whey based amla beverage was estimated by 2,6-dichloro indophenols fibrimetric method as described in procedure 967.21, AOAC manual 16th Ed, Vol. II, 1995.

**Results and Discussion**

**Shelf life assessment of whey based amla beverage**

In the current observation on shelf life assessment of fresh whey based amla beverage reported that the beverage holds well till 10th day of storage at 5°C. Visco-De-Velez, (1986) reported that processed nutritional whey drink had a shelf life of up to 45 days at refrigerated temperature.

Similarly, Kumar and Tiwari (2004) studied about the development of whey based fermented milk beverages and showed that the beverages kept well up to 6 days at refrigeration temperature. The results obtained in the current study were in agreement with Kumar and Tiwari (2004) who assessed the shelf life of whey based fermented milk beverages.

The shelf life assessment of fresh whey based amla beverage holds well till 4th day of storage at 30°C. Singh et al. (2003) reported that whey-mango concentrate and whey-apple concentrate could be keep well for 45 days at 25°C of storage.

Khamrui and Pal, (2003) found that whey based Kinnow juice concentrate (WKJP) packed in metalized polyester pouches at 25°C storage temperature had a shelf-life of more than 6 months. The results obtained in the current study was not in agreement with Singh et al. (2003) and Khamrui and Pal, (2003) who assessed the shelf life of whey mango concentrate and whey based kinnow juice concentrate as because the whey based amla beverage was subjected to minimal processing.

**Effect of light on ascorbic acid on storage**

The effect of light on ascorbic acid (mg/100ml) of whey based amla beverage stored at refrigeration and room conditions
shown in Figure-1. The studies revealed the existence of significant difference in the ascorbic acid content of the whey based amla beverage stored at refrigerated and room temperature under light. The mean ± SD values of six trials for the percentage of ascorbic acid (mg/100ml) in whey based amla beverage was noted as 250.4±0.35 on 1st day; 218.3±0.53 and 147.5±0.62 on 4th day; 187.1±0.81 and 103.5±0.74 on 7th day; and 143.7±0.47 and 84.6±0.53 on 10th day respectively. It was observed that the ascorbic acid content declines steadily with respect to the storage temperature and time under light.

Nagy and Smoot, (1977) stated that the stability of ascorbic acid is affected by both intrinsic and extrinsic factors like temperature, pH, handling, processing and storage. The results obtained were in agreement with the statement cited by Nagy and Smoot. Further, Gregory, (2008) stated that loss of vitamin C not only occurs by high temperature but also by chemical degradation during preparation because of the high solubility of vitamin C in aqueous solution during storage and handling.

The studies pertaining to enrichment of amlavitamin C in whey has not been documented in the literature but however studies on effect of retention and stability of vitamin A in whey drink stored under light has been reported by Dhandayuthapani et al. (1997). The authors witnessed the loss of vitamin-A on samples stored at room and refrigeration temperature during the first 15 days of the study which is due to the effect of light.In the current study similar effect of light on the ascorbic acid content of the whey based amla beverage has been observed. Hence the results obtained were compared with the Dhandayuthapani et al. (1997) who reported no significant difference in the loss vitamin-A existed on the sample kept on different storage conditions. It was

### Table 1  Effect of light on ascorbic acid content (mg/100ml) in whey based amla beverage stored at different storage condition

<table>
<thead>
<tr>
<th>Storage days</th>
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<th>Room temperature (27°C)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1st day</td>
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<td>10th day</td>
<td>143.7±0.47</td>
<td>84.6±0.53</td>
</tr>
</tbody>
</table>

# Percentages (Mean ± SD). Average of six trials.
Whey based amla beverage : Amla extract substituted at 1:1 ratio (v/v basis) to the whey

### Table 2  Effect of darkness on ascorbic acid content (mg/100ml) of the whey based amla beverage stored at different storage condition

<table>
<thead>
<tr>
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<th>Room temperature (27°C)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1st day</td>
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</tr>
<tr>
<td>4th day</td>
<td>232.6±0.52</td>
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<td>7th day</td>
<td>221.8±0.47</td>
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<td>10th day</td>
<td>209.3±0.61</td>
<td>117.3±0.64</td>
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</tbody>
</table>

# Percentages (Mean ± SD). Average of six trials.
Whey based amla beverage : Amla extract substituted at 1:1 ratio (v/v basis) to the whey
found that the results obtained in the current study were in contrast with the results obtained by Dhandayuthapani et al. (1997).

Effect of darkness on ascorbic acid on storage

The effect of darkness on ascorbic acid (mg/100ml) of whey based amla beverage stored at refrigeration and room conditions shown in Figure-2. The studies revealed the existence of significant difference in the ascorbic acid content of the whey based amla beverage stored at refrigerated and room temperature under darkness. The mean SD values of six trials for the percentage of ascorbic acid (mg/100ml) in whey based amla beverage was noted as 250.4±0.35 on 1st day; 232.6±0.52 and 173.6±0.69 on 4th day; 221.8±0.47 and 139.2±0.57 on 7th day; and 209.3±0.61 and 117.3±0.64 on 10th day respectively. It was observed that the ascorbic acid content of whey based amla beverage showed reduction in values with respect to storage temperature and time. It was also noted that the retention of ascorbic acid in whey based amla beverage stored under darkness was comparatively higher than the beverage stored under light irrespective of the storage time and temperature.

Osganian, (2003) stated that Vitamin C is the most easily destroyed when exposed to oxygen and temperature, (above 70°C) it leaks out into water because of its water soluble nature. Further Nagy and Smoot, (1977) stated that the stability of ascorbic acid decreases with increase in temperature, pH, handling, processing and storage. The results obtained in the current study was in agreement with the discussion citied by Osganian (2003); and Nagy and Smoot, (1977).

Dhandayuthapani et al. (1997) reported that there existed no significant difference in the loss vitamin-A on the whey drink fortified with Vitamin A kept under different storage conditions. But in contrast, in the current study on effect of storage condition on ascorbic acid content of the whey based amla beverage it was found significant.

Conclusions

From the studies it may be noted that the condition of storage has severe impact on the ascorbic content of the whey based amla beverage. It is advice able to store the whey based amla beverage in dark condition at refrigeration temperature to improve the retention of ascorbic acid and also to extend the shelf life. From the studies it may be concluded that the whey based amla beverage can be packed in packaging material which is a good barrier to light and oxygen. Further studies have to be carried out to identify the best packaging material for maximum retention of ascorbic acid and longevity of storage life.

References


