ISSN: 0974 - 0376

The Ecoscan : Special issue, Vol. IX: 297-301: 2016
AN INTERNATIONAL QUARTERLY JOURNAL OF ENVIRONMENTAL SCIENCES
www.theecoscan.com

# PHYSICO-CHEMICAL CHARACTERS AND STORAGE BEHAVIOUR OF RTS PREPARED FROM AONLA BASED BLENDS

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**KEYWORDS**

Aonla
RTS
Physico-chemical
Storage behaviour

**Proceedings of National Conference on**
**Harmony with Nature in Context of**
**Resource Conservation and Climate Change**
(HARMONY - 2016)
October 22 - 24, 2016, Hazaribag,
organized by
Department of Zoology, Botany, Biotechnology & Geology
Vinoba Bhave University,
Hazaribag (Jharkhand) 825301
in association with
National Environmentalists Association, India
www.neaindia.org

The Ecoscan
AN INTERNATIONAL QUARTERLY JOURNAL OF ENVIRONMENTAL SCIENCES

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## ABSTRACT

The physico-chemical properties, sensory quality, storage behavior of the aonla RTS blended with other fruits such as pineapple, grapes and pomegranate were studied at initial, 15, 30, 45 and 60 days after storage and the experiment was laid down in a factorial completely randomized design with ten treatments and three replications. An increasing trend in TSS, total sugars, reducing sugars and acidity and decreasing trend in ascorbic acid content, total phenols and the organoleptic scores for overall acceptability was noticed during storage period of 60 days. Irrespective of the treatments, no microorganism was detected upto 15$^{th}$ day of storage period. Among all the treatments $T_4$ (25% aonla juice + 75% grapes juice) was found best in the aonla based blended RTS beverages with respect to most of the physico-chemical parameters viz., higher TSS, total sugars, reducing sugars, ascorbic acid content and overall acceptability.

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## INTRODUCTION

Aonla or amla (*Emblica officinalis*. Gaertn), popularly known as the Indian gooseberry, is a small-sized, minor subtropical fruit and is indigenous to Indian sub-continent, which can be grown successfully in dry and neglected regions. Aonla is one of the oldest Indian fruits and considered as "*Wonder fruit for health*" because of its unique qualities. It is probably the only fruit to fill the gap of astringent food recommended by ayurvedic system of medicine for a balanced diet and sound health. It is a rich source of Vitamin C (500-1500mg/100g) and of other nutrients such as polyphenols, pectin, iron, calcium and phosphorus (Singh et al., 1993; Khopde *et al.,* 2001). The fruit is a potent antioxidant, hypolipidemic, antibacterial and it has antiviral properties.

Fruit of aonla is not consumed in fresh form because of its highly acidic and astringent taste, low TSS (total soluble solids), lack of flavour, and poor colour. Earlier, workers have explored the possibilities of utilizing aonla fruit for the preparation of juice and beverages (Singh and Kumar, 1995). Although, aonla fruit juice and beverages prepared there from have poor consumer acceptance. So to improve the nutritional quality and consumer acceptance of aonla juice best method is though blending aonla juice with other fruit juices. Blending can improve the vitamin and mineral contents depending upon the kind and quality of fruits used (De Carvalho *et al*., 2007).

There is great possibility of obtaining an excellent quality RTS, if aonla pulp is blended with pineapple, grapes and pomegranate because pineapple is a rich source of vitamin C (50 mg/100 g) and minerals like calcium, phosphorus and iron. The fruit also contains bromelain, a proteolytic enzyme. Grape is a thirst-quencher, rich in sugars, acids, minerals, vitamins and tannins. Pomegranate is good source of sugars (14-16%), minerals (0.7-1.0%) and fair source of iron (0.3-0.7 mg/100g). It is having pharmacological properties as anticarcinogenic and anti-inflammatory (Mohammad and Kashani, 2012).

The present paper deals with experiment conducted to find out physico-chemical characters and storage behaviour of RTS prepared from aonla based blends.

## MATERIALS AND METHODS

The present investigation was conducted by blending with different fruit juices of pineapple, grape and pomegranate was carried out in the Laboratory of Department of Post Harvest Technology, Horticultural College and Research Institute, Venkataramannagudem, West Godavari District of Andhra Pradesh during the year 2015-16.

For the present investigation aonla fruits were procured from the fruit market, at Rajahmundry town, E.G district, Andhra Pradesh. Pineapple cv. Kew, grapes cv. Banglore blue and pomegranate fruits were obtained from the local fruit market of Tadepalligudem, W.G district, Andhra Pradesh. Well ripe fruits were collected and washed. Diseased, withered fruits were discarded. The fruit juice was extracted as per the procedure outlined by Srivastava and Kumar (2002).

The RTS was prepared from aonla juice blended in different proportions *viz*., 25:75, 50:50, 75:25 with pineapple, grapes and pomegranate juice as per the respective treatment combinations and maintained with 10% TSS and 0.3% acidity as per FPO specification. They were filled in sterilized bottle of 200 ml size each and crown corked. The bottles were pasteurized in boiling water at 65°C for 30 minutes then cooled and stored at room temperature (Srivastava and Kumar, 2002)). The treatment details are given below:

$T_1$ : RTS prepared from blend of 25% Aonla juice + 75% Pineapple juice

$T_2$ : RTS prepared from blend of 50% Aonla juice+ 50% Pineapple juice

$T_3$ : RTS prepared from blend of 75% Aonla juice + 25% Pineapple juice

$T_4$ : RTS prepared from blend of 25% Aonla juice + 75% Grape juice

$T_5$ : RTS prepared from blend of 50% Aonla juice + 50% Grape juice

$T_6$ : RTS prepared from blend of 75% Aonla juice + 25% Grape juice

$T_7$ : RTS prepared from blend of 25% Aonla juice + 75% Pomegranate juice

$T_8$ : RTS prepared from blend of 50% Aonla juice + 50% Pomegranate juice

$T_9$ : RTS prepared from blend of 75% Aonla juice + 25% Pomegranate juice

$T_{10}$ : RTS prepared from control (100% Aonla juice)

The experiment was laid out in a completely randomized design, replicated three times. The data collected on the following observations during the course of investigation were statistically analyzed by adopting the standard procedure of Panse and Sukhatme (1985). The physico-chemical parameters like total soluble solids (°Brix) was determined by hand refractometer. Acidity was determined by titrating the juice against N/10 NaOH and expressed as percent of citric acid, whereas ascorbic acid (mg/100mL) was determined by titrating the product against 2,6-dichlorophenol indophenol indicator (Ranganna, 1986). Sugars (reducing, non reducing and total sugars) were determined by the method given by Lane and Eynon (AOAC, 1984). Total phenolic composition was determined by using Folin - Ciocalteu method and expressed as gallic acid equivalents (GAE) (Jayasingh *et al*., 2003). Microbial count were estimated by following dilution plate method.

## RESULTS AND DISCUSSION

### Total Soluble Solids (°Brix)

The average TSS among all treatments was found to show significant increase from the day of preparation (10.13 °B) to 60 days after preparation (10.82 °B). (Table 1).Among treatments, all the blends recorded a higher value for TSS compared to the RTS prepared from 100% aonla juice. The highest value of TSS (10.81 °B) was found in the 25% aonla juice + 75% grape juice ($T_4$). The lowest TSS (10.17 °B) was found in the RTS prepared from 100% aonla juice ($T_{10}$). The present findings are in agreement with those of Kumar *et al*. (2010) in aonla-guava blended RTS, Jain and Meena (2013) in aonla-kinnow mandarin blended RTS and Apurwa(2015) in jamum RTS respectively. The increase in TSS of the RTS was due to conversion of left over polysaccharides into soluble sugars and formation of water soluble pectin from protopectin.

### Titrable acidity (%)

The percentage of titrable acidity significantly increased from the day of preparation (0.29%) to 60 days of storage (0.36%) (Table 1). Among the treatments, the lowest titrable acidity (0.30%) was found in the RTS prepared from 25% aonla juice + 75% grape juice ($T_4$) and 50% aonla juice + 50% grape juice ($T_5$) . Titrable acidity was found to be at maximum (0.35%) in RTS prepared from pure aonla juice ($T_{10}$) and 50 % aonla + 50 % pineapple juice ($T_2$). Similar result was observed by Sasikumar (2013) in RTS beverage blend of Aloe Vera and aonla fruit. The increase in titrable acidity may be due to

**Table 1: Changes in total soluble solids, titrable acidity and total sugars of aonla based RTS during storage**

| Treatments | Total soluble solids (°Brix) | | | | | | Titrable acidity (%) | | | | | | Total sugars (%) | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Days after storage | | | | | | | | | | | | | | | | | |
| | Initial | 15 | 30 | 45 | 60 | Mean | Initial | 15 | 30 | 45 | 60 | Mean | Initial | 15 | 30 | 45 | 60 | Mean |
| $T_1$ | 10.11 | 10.23 | 10.54 | 10.72 | 10.81 | 10.48 | 0.27 | 0.29 | 0.33 | 0.35 | 0.38 | 0.32 | 11.12 | 11.96 | 12.22 | 12.43 | 12.77 | 12.10 |
| $T_2$ | 10.10 | 10.21 | 10.46 | 10.65 | 10.83 | 10.45 | 0.29 | 0.32 | 0.35 | 0.38 | 0.39 | 0.35 | 10.98 | 11.53 | 11.84 | 12.08 | 12.49 | 11.79 |
| $T_3$ | 10.08 | 10.11 | 10.42 | 10.53 | 10.71 | 10.37 | 0.30 | 0.33 | 0.35 | 0.36 | 0.37 | 0.34 | 10.74 | 11.02 | 11.48 | 12.22 | 12.43 | 11.58 |
| $T_4$ | 10.32 | 10.54 | 10.81 | 11.11 | 11.26 | 10.81 | 0.26 | 0.28 | 0.29 | 0.32 | 0.33 | 0.30 | 12.96 | 13.23 | 13.68 | 13.95 | 14.15 | 13.60 |
| $T_5$ | 10.26 | 10.45 | 10.63 | 10.92 | 11.03 | 10.66 | 0.27 | 0.28 | 0.29 | 0.31 | 0.33 | 0.30 | 12.26 | 12.75 | 13.25 | 13.64 | 13.80 | 13.14 |
| $T_6$ | 10.16 | 10.42 | 10.53 | 10.73 | 10.91 | 10.55 | 0.28 | 0.30 | 0.34 | 0.35 | 0.36 | 0.33 | 11.48 | 11.73 | 11.91 | 12.25 | 12.85 | 12.05 |
| $T_7$ | 10.10 | 10.26 | 10.53 | 10.75 | 10.86 | 10.50 | 0.28 | 0.30 | 0.31 | 0.32 | 0.35 | 0.31 | 12.20 | 12.34 | 12.78 | 12.99 | 13.23 | 12.71 |
| $T_8$ | 10.10 | 10.24 | 10.41 | 10.72 | 10.83 | 10.46 | 0.30 | 0.31 | 0.33 | 0.34 | 0.37 | 0.33 | 11.70 | 11.90 | 12.40 | 12.77 | 12.97 | 12.35 |
| $T_9$ | 10.08 | 10.15 | 10.39 | 10.56 | 10.67 | 10.37 | 0.31 | 0.32 | 0.34 | 0.35 | 0.36 | 0.34 | 11.20 | 11.73 | 11.96 | 12.35 | 12.42 | 11.93 |
| $T_{10}$ | 10.02 | 10.04 | 10.15 | 10.28 | 10.35 | 10.17 | 0.31 | 0.34 | 0.35 | 0.36 | 0.38 | 0.35 | 10.48 | 10.99 | 11.22 | 11.67 | 11.81 | 11.24 |
| Mean | 10.13 | 10.26 | 10.48 | 10.69 | 10.82 | | 0.29 | 0.31 | 0.33 | 0.34 | 0.36 | | 11.52 | 11.92 | 12.28 | 12.64 | 12.89 | |

| | Total soluble solids | | | Titrable acidity | | | Total sugars | | |
|---|---|---|---|---|---|---|---|---|---|
| | D(Days) | T(Treatments) | D × T | D(Days) | T(Treatments) | D × T | D(Days) | T(Treatments) | D × T |
| S.E (m) | 0.002 | 0.003 | 0.006 | 0.001 | 0.002 | 0.004 | 0.026 | 0.036 | 0.081 |
| CD at 5% | 0.005 | 0.007 | 0.016 | 0.003 | 0.005 | 0.010 | 0.072 | 0.102 | 0.227 |

**Table 2: Changes in reducing sugars, non-reducing sugars and ascorbic acid content of aonla based RTS during storage**

| Treatments | Reducing sugars (%) Days after storage | | | | | | Non-reducing sugars (%) | | | | | | Ascorbic acid content (mg/ 100ml) | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Initial | 15 | 30 | 45 | 60 | Mean | Initial | 15 | 30 | 45 | 60 | Mean | Initial | 15 | 30 | 45 | 60 | Mean |
| $T_1$ | 3.93 | 4.81 | 5.76 | 6.16 | 6.90 | 5.41 | 7.19 | 7.15 | 6.46 | 6.27 | 5.87 | 6.58 | 28.01 | 27.62 | 25.64 | 24.88 | 22.64 | 25.75 |
| $T_2$ | 3.74 | 4.35 | 4.71 | 5.35 | 6.02 | 4.83 | 7.24 | 7.18 | 7.13 | 6.73 | 6.47 | 6.86 | 30.27 | 28.27 | 27.42 | 26.70 | 24.44 | 27.42 |
| $T_3$ | 3.32 | 3.63 | 4.11 | 4.91 | 5.14 | 4.22 | 7.42 | 7.39 | 7.37 | 7.31 | 7.29 | 7.43 | 33.15 | 30.92 | 29.66 | 28.47 | 27.69 | 29.97 |
| $T_4$ | 5.54 | 6.17 | 6.98 | 7.42 | 7.87 | 6.79 | 7.42 | 7.06 | 6.70 | 6.53 | 6.28 | 6.80 | 26.57 | 25.64 | 23.90 | 22.64 | 18.90 | 23.53 |
| $T_5$ | 5.35 | 5.99 | 6.57 | 7.02 | 7.25 | 6.43 | 6.91 | 6.76 | 6.68 | 6.62 | 6.55 | 6.71 | 27.68 | 26.62 | 24.82 | 23.12 | 21.90 | 24.82 |
| $T_6$ | 4.95 | 5.65 | 5.95 | 6.31 | 6.98 | 5.96 | 6.53 | 6.08 | 5.96 | 5.94 | 5.87 | 5.85 | 29.74 | 28.26 | 28.03 | 27.31 | 26.15 | 27.89 |
| $T_7$ | 4.41 | 5.12 | 5.98 | 6.54 | 6.99 | 5.80 | 7.79 | 7.22 | 6.80 | 6.45 | 6.24 | 6.90 | 25.97 | 24.38 | 23.22 | 21.20 | 20.13 | 22.98 |
| $T_8$ | 4.22 | 4.74 | 5.49 | 6.02 | 6.57 | 5.40 | 7.48 | 7.16 | 6.91 | 6.75 | 6.40 | 6.94 | 26.22 | 24.78 | 23.69 | 21.77 | 20.31 | 23.23 |
| $T_9$ | 3.98 | 4.49 | 4.74 | 5.75 | 6.12 | 5.01 | 7.22 | 7.24 | 7.22 | 6.60 | 6.30 | 6.91 | 28.85 | 28.43 | 27.07 | 26.14 | 24.69 | 27.03 |
| $T_{10}$ | 2.71 | 3.29 | 3.54 | 4.15 | 4.35 | 3.60 | 7.77 | 7.70 | 7.68 | 7.52 | 7.46 | 7.63 | 35.62 | 33.22 | 32.74 | 31.74 | 31.47 | 32.95 |
| Mean | 4.22 | 4.77 | 5.38 | 5.96 | 6.33 | | 7.30 | 7.09 | 6.89 | 6.67 | 6.48 | | 29.20 | 27.81 | 26.61 | 25.33 | 23.83 | |

| | Reducing sugars | | | Non-reducing sugars | | | Ascorbic Acid | | |
|---|---|---|---|---|---|---|---|---|---|
| | D(Days) | T(Treatments) | D × T | D(Days) | T(Treatments) | D × T | D(Days) | T(Treatments) | D × T |
| S.E (m) | 0.009 | 0.013 | 0.029 | 0.018 | 0.026 | 0.058 | 0.044 | 0.062 | 0.139 |
| CD at 5% | 0.026 | 0.036 | 0.081 | 0.051 | 0.073 | 0.162 | 0.123 | 0.174 | 0.389 |

**Table 3: Changes in microbial count, Total phenols and overall acceptability of aonla based RTS during storage**

| Treatments | Microbial count(x $10^4$ CFU/g) Days after storage | | | | | | Total phenols (Gallic acid equivalents) | | | | | | Overall acceptability | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Initial | 15 | 30 | 45 | 60 | Mean | Initial | 15 | 30 | 45 | 60 | Mean | Initial | 15 | 30 | 45 | 60 | Mean |
| $T_1$ | 0.00 | 1.46 | 1.63 | 1.73 | 1.80 | 1.32 | 618.35 | 614.07 | 609.22 | 602.06 | 595.08 | 607.76 | 8.03 | 7.83 | 7.63 | 7.53 | 7.33 | 7.67 |
| $T_2$ | 0.00 | 1.50 | 1.66 | 1.76 | 1.93 | 1.37 | 666.88 | 662.24 | 656.16 | 650.08 | 645.26 | 656.13 | 7.43 | 7.23 | 7.13 | 7.03 | 6.83 | 7.13 |
| $T_3$ | 0.00 | 1.43 | 1.53 | 1.73 | 1.83 | 1.30 | 714.56 | 710.36 | 705.34 | 701.91 | 696.57 | 705.75 | 7.03 | 6.93 | 6.83 | 6.63 | 6.43 | 6.77 |
| $T_4$ | 0.00 | 1.80 | 2.00 | 2.23 | 2.46 | 1.70 | 762.83 | 757.43 | 750.05 | 744.87 | 737.57 | 750.55 | 8.13 | 8.03 | 7.83 | 7.63 | 7.53 | 7.83 |
| $T_5$ | 0.00 | 1.76 | 1.86 | 1.96 | 2.36 | 1.59 | 813.75 | 808.22 | 802.03 | 796.57 | 790.06 | 802.13 | 8.23 | 8.03 | 7.93 | 7.73 | 7.63 | 7.9 |
| $T_6$ | 0.00 | 1.40 | 1.50 | 1.70 | 1.90 | 1.30 | 868.24 | 862.08 | 856.36 | 851.52 | 845.25 | 856.69 | 7.33 | 7.23 | 7.13 | 6.93 | 6.73 | 7.07 |
| $T_7$ | 0.00 | 1.43 | 1.60 | 1.73 | 1.86 | 1.32 | 761.34 | 757.07 | 752.23 | 745.06 | 740.58 | 751.26 | 6.36 | 6.23 | 6.13 | 5.93 | 5.83 | 6.09 |
| $T_8$ | 0.00 | 1.43 | 1.56 | 1.70 | 1.76 | 1.29 | 818.08 | 813.98 | 808.98 | 801.78 | 796.24 | 807.81 | 6.43 | 6.23 | 6.03 | 5.83 | 5.43 | 5.99 |
| $T_9$ | 0.00 | 1.50 | 1.63 | 1.73 | 1.86 | 1.34 | 873.45 | 869.87 | 864.08 | 857.98 | 850.24 | 863.13 | 6.23 | 6.03 | 5.93 | 5.43 | 5.33 | 5.79 |
| $T_{10}$ | 0.00 | 1.33 | 1.46 | 1.60 | 1.73 | 1.22 | 908.34 | 903.35 | 898.45 | 892.36 | 885.06 | 897.51 | 6.03 | 5.93 | 5.83 | 5.43 | 5.23 | 5.69 |
| Mean | 0.00 | 1.50 | 1.64 | 1.79 | 1.95 | | 780.58 | 775.87 | 770.29 | 764.42 | 758.18 | | 7.12 | 6.97 | 6.84 | 6.61 | 6.43 | |

| | Microbial count | | | Total phenols | | | Overall acceptability | | |
|---|---|---|---|---|---|---|---|---|---|
| | D(Days) | T(Treatments) | D × T | D(Days) | T(Treatments) | D × T | D(Days) | T(Treatments) | D × T |
| S.E (m) | 0.036 | 0.025 | 0.080 | 0.022 | 0.031 | 0.069 | 0.015 | 0.011 | 0.033 |
| CD at 5% | 0.101 | 0.071 | 0.225 | 0.062 | 0.087 | 0.195 | 0.042 | 0.030 | 0.094 |

formation of organic acids by ascorbic acid degradation as well as progressive decrease in the astringent and polyphenolic compounds and pectin substances.

**Sugars (%)**

The percentage of total sugars and reducing sugars increased significantly from the day of preparation to 60 days after storage (Table 1&2)

Among different treatments, all the blends recorded a higher percentage of total sugars and reducing sugars compared to RTS prepared from 100% aonla juice. The highest value of total sugars (13.60 %) and reducing sugars (6.79 %) was found in the RTS prepared from 25% aonla juice + 75% grape juice ($T_4$). The RTS prepared from the aonla juice 100% ($T_{10}$) was found to have the least quantity of total sugars (11.24 %) and reducing sugars (3.60 %). The non-reducing sugars were found to decline significantly from the day of preparation to 60 days of storage. Among the treatments, the highest percentage of non-reducing sugars (7.63 %) was observed in RTS prepared from 100% aonla juice ($T_{10}$). The lowest percentage of non-reducing sugars (5.85%) was found in the RTS from 75% aonla juice + 25% grapes juice ($T_6$). These findings are in accordance with Kumar *et al*. (2010) in aonla-guava blended beverages, Byanna and Gowda (2012) in sweet orange RTS beverages and Apurwa (2015) in jamum RTS. The increase in reducing sugars as well as total sugars and decrease in non-reducing sugar in aonla blended RTS could be because of responsive varietal biochemical constituents. The variation in different fractions of sugar was due to hydrolysis of polysaccharides like pectin and starch and inversion of non-reducing sugar into reducing sugars, as increase in reducing sugar was correlated with the decrease in non-reducing sugars. The increased level of total sugars was due to conversion of starch and pectin into simple sugars.

**Ascorbic acid (mg/100 ml)**

It was observed that the ascorbic acid content of RTS declined significantly from 29.20 mg/100 ml at initial day to 23.83 mg/ 100 ml at 60 days of storage period. (Table 2).Among the treatments, all the blends recorded a minimum retention of

ascorbic acid compared to RTS prepared from 100% aonla juice. The maximum retention of ascorbic acid content (32.95 mg/100 ml) was observed in the RTS prepared from 100 % aonla juice ($T_{10}$). The minimum ascorbic acid content (22.98 mg/100 ml) was observed in the RTS from 25% aonla juice + 75% pomegranate juice ($T_7$). Increasing the proportion of aonla juice in blends obviously increased vitamin C content.. Similar reduction in ascorbic acid content have also been reported by Gaikwad *et al*. (2013) in low calorie herbal aonla-ginger RTS beverages and Praveen *et.al* (2015) in mango candy. The reduction in ascorbic acid might be attributed to the oxidation of ascorbic acid into dehydroascorbic acid by oxygen.

**Total phenols (Gallic acid equivalents)**

The average GAE has decreased significantly from 780.58 mg/ 100 ml (initial day) to 758.18 mg/ 100 ml (60 days) (Table 3). The RTS prepared from 100% aonla juice recorded significantly higher total phenols compared to all other blends. The lowest value of total phenols in terms of gallic acid equivalents (GAE) (607.76 mg/100 ml) was observed in the RTS prepared from 25% aonla juice + 75% pineapple juice ($T_1$) and the highest gallic acid equivalents (GAE) (897.51 mg/ 100 ml) was observed in the RTS prepared from 100% aonla juice ($T_{10}$). These results are in line with Kumar *et al*. (2010) in aonla- guava blended beverages, Singh *et al*. (2014) in ginger honey blended RTS beverages and Praveen *et.al* (2015) in mango candy. The loss of phenolic compounds during the storage might be due to the polymerization of phenolic compounds with increasing storage.

**Microbial count (Microbial count x $10^6$ CFU/g)**

There is no microbial growth in the RTS beverages prepared at initial day of storage (Table 3).The increase in microbial load after 15 days of storage was negligible and safe for consumption.Increase in microbial count observed in all the treatments with the advancement of storage period at room temperature depends upon the environment available to the microbes and the storage temperature. Similar results were also presented by Kumar *et al*. (2010) in aonla- guava blended beverages and Singh *et al*. (2014) in ginger honey blended RTS beverages.

**Overall acceptability**

The overall acceptability was significantly decreased throughout the storage period from the day of preparation (7.12) to 60 days of storage (6.43) (Table 3). All the blends recorded a higher score for overall acceptability compare to RTS prepared from 100% aonla juice. The maximum overall acceptability (7.90) was observed in the RTS prepared from 50% aonla juice + 50% grape juice ($T_5$). The lowest score (5.69) was observed in the RTS prepared from 100% aonla juice ($T_{10}$). Similar results were reported by Chandan *et al*. (2012) in RTS beverage from drained aonla syrup. Temperature plays an important role in inducing certain biochemical changes in the product which leads to the formation of off-flavour and discolouration and thus masking the original taste, flavour and colour of the product.

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