The Pharma Innovation Journal 2018; 7(2): 167-172

www.ThePharmaJournal.com

The Pharma Innovation

ISSN (E): 2277- 7695
ISSN (P): 2349-8242
NAAS Rating: 5.03
TPI 2018; 7(2): 167-172

www.thepharmajournal.com
Received: 21-12-2017
Accepted: 22-01-2018

NS Thakur
Department of Food Science and Technology, Dr YS Parmar University of Horticulture and Forestry, Nauni, Solan, Himachal Pradesh, India

Nancy Thakur
Department of Food Science and Technology, Dr YS Parmar University of Horticulture and Forestry, Nauni, Solan, Himachal Pradesh, India

Hamid
Department of Food Science and Technology, Dr YS Parmar University of Horticulture and Forestry, Nauni, Solan, Himachal Pradesh, India

Abhimanyu Thakur
Department of Food Science and Technology, Dr YS Parmar University of Horticulture and Forestry, Nauni, Solan, Himachal Pradesh, India

Correspondence
Hamid
Department of Food Science and Technology, Dr YS Parmar University of Horticulture and Forestry, Nauni, Solan, Himachal Pradesh, India

Studies on development and storage quality evaluation of vitamin C rich syrup prepared from wild aonla (*Phyllanthus emblica* L.) fruits

NS Thakur, Nancy Thakur, Hamid and Abhimanyu Thakur

Abstract
Wild aonla is a fruit which has got great commercial importance due to higher amount of anti-oxidants such as vitamin C (598.32 mg/100 g) and total phenols (15.98 mg/g). In the present study syrup was prepared from wild aonla juice and quality evaluation was carried out during six months of storage. Different combinations of juice (25%, 30%, 35% and 40%) and TSS (65 ºB and 70 ºB) were tried to standardize proper combination for the development of syrup. Out of 8 different treatment combinations of juice and TSS tried, syrup with 35 per cent juice, 65 ºB TSS and 1.80 per cent acid was found to be best on the basis of sensory and some physico-chemical characteristics of the product. The standardized recipe (T_3) of syrup contains higher ascorbic acid content (180.71 mg/100 g), reducing sugars (44.28%), total sugars (61.98%) and higher total phenols (5.49 mg/g) with highest sensory scores for colour (8.15), body (8.00), taste (8.31), aroma (8.12) and overall acceptability (8.10). The syrup prepared by following the best selected recipe was packed in glass and PET bottles and stored for six months under ambient (20-25 ºC) and refrigerated temperature (4-7 ºC) conditions. However, the changes in the quality characteristics of the syrup were slower in refrigerated storage conditions as compared to ambient conditions. Both the packaging materials viz. PET and glass bottles were found suitable, with comparatively less changes occurring in glass bottles stored under refrigerated conditions.

Keywords: Wild aonla, syrup, storage, ascorbic acid, phenols, packaging material

Introduction
Wild aonla (*Phyllanthus emblica* L.) or Indian gooseberry belongs to family Euphorbiaceae and its genus *Phyllanthus* comprises about 350 to 500 species which includes shrubs, trees and some herbs. It is indigenous to tropical South East Asia, particularly in Central and Southern India (Parmar and Kaushal, 1982) [1] from where it spread to Sri Lanka, Malaysia and China. India ranks first in the world with respect to area and production of cultivated aonla (Priya and Khatkar, 2013) [2]. It is widely distributed in Uttar Pradesh, Maharashtra, Gujarat, Rajasthan, Andhra Pradesh, Karnataka, Tamil Nadu, Haryana and Himachal Pradesh. Although the wild aonla is widely distributed in the forests of HP up to an elevation of 1450 m above mean sea level (Parmar and Kaushal, 1982) [1], but there are no records of its area and production. Wild aonla is a deciduous tree, small to medium in size having 5.5 m height. It flowers in the end of April and fruits are ready for harvest during February-March (Parmar and Kaushal, 1982) [1]. Aonla fruit is a rich source of ascorbic acid, phenols, sugars, pectin, starch and minerals (Nath *et al.*, 1992) [3]. Being rich source of ascorbic acid, it contains about 20 times more vitamin C than the citrus fruits (Parmar and Kaushal, 1982)) [1]. It is considered to be a "wonder fruit for health" because of its unique properties. It is used in Ayurvedic and Unani systems of Indian medicines. Its fruits are astringent, carminative, digestive, stomachic, diuretic, antipyretic and also useful in curing many diseases like diabetes, cough, asthma, bronchitis, headache, dyspepsia, colic, flatulence, skin diseases, leprosy, jaundice, scurvy, and diarrhoea (Ganachari *et al.*, 2010) [4]. It also contains leucoanthocyanins along with polyphenols which maintain the stability of ascorbic acid as well as astringency of the fruit (Radha and Mathew, 2007) [5]. Tannins (gallic acid and elagic acid) and glucose render its value as antiscorbutic in fresh as well as dried conditions (Pareek and Kaushik, 2012) [6]. Antioxidant property of aonla fruit results from the presence of high density of ellagitannins such as emblicanin A (37%), emblicanin B (33%), punigluconin (12%) and pedunculagin (14%) (Bhattacharya *et al.*, 1999) [7]. However, it is not consumed much as fresh fruit as it is highly acidic and astringent in taste. Therefore, it is necessary to convert the aonla juice into certain beverages before it can be consumed.

As the nutritive value of fruit based beverages is much more than the synthetic products, which are available in the market throughout the country. Therefore, Keeping in view the availability of this fruit in the forests of HP and importance with respect to its quality characteristics, such as natural antioxidants especially vitamin C and phenols, the present studies were under taken with the objective to develop syrup from this underutilized fruit and to study effect of storage on its chemical constituents.

Materials and methods

Collection of fruits and standardization of the recipe

The mature fruits of *Phyllanthus emblica* L. procured from Chandesh area of Mandi district of Himachal Pradesh in the year 2015-16 and brought to Department of Food Science and Technology, Dr YSP UHF Nauni, Solan (HP). Packaging materials like PET bottles and glass bottles were procured from local market. The juice from the aonla fruits after shredding through grater was easily extracted by using hydraulic press machine. Fruit syrup was prepared by mixing aonla juice with sugar syrup in different combinations as given in Table 1. To get the desirable concentration of acid (1.80%) in syrup, citric acid was added in different treatment combinations. SO_2 (350 ppm) was added to all the treatment combinations as preservative.

Table 1: Treatment detail of syrup

Treatment	T_1	T_2	T_3	T_4	T_5	T_6	T_7	T_8
Juice (%)	25	30	35	40	25	30	35	40
TSS (%)	65	65	65	65	70	70	70	70

Packaging and storage

The syrup prepared by following the best selected recipe was packed in pre-sterilised glass and PET (polyethylene terephthalate) bottles (700 ml capacity). All the packed products were properly labelled and stored in ambient (20-25 ^oC) and low temperature (4-7 ^oC) conditions for six months. The physico-chemical and sensory characteristics of best selected product were estimated at zero, three and six months of storage.

Physico-chemical analysis and sensory evaluation

The colour of syrup in terms of different tintometer colour units (TCU) was observed with Tintometer (Lovibond Tintometer Model-E). TSS, reducing sugars, total sugars and titratable acidity of prepared product were determined according to method described by Ranganna (2009) [8]. The pH of the samples was determined by using a digital pH meter (CRISON Instrument, Ltd, Spain). Total phenols content (mg/g) was determined by Folin-Ciocalteu procedure given by Singleton and Rossi (1965) [9]. Nine points hedonic rating test was followed for conducting the sensory evaluation of syrup (Amerine *et al.*, 1965) [10]. The panel of ten judges was selected to evaluate the product for sensory parameters such as colour, body, taste, aroma and overall acceptability. Data on physico-chemical characteristics of syrup was analysed by Completely Randomized Design (CRD) before and during storage, whereas, data pertaining to the sensory evaluation were analyzed by using Randomized Block Design (RBD) as described by Mahony (1985) [11]. The experiments on recipe standardization and storage studies were replicated three times.

Results and discussion

Standardization of recipe for the preparation of syrup

The data pertaining to physico-chemical and sensory characteristics of wild aonla syrup prepared by following different recipes have been presented in Table 2 to 3.

Physico-chemical characteristics

Data pertaining to physico-chemical characteristics of different recipes of wild aonla syrup presented in Table 2 indicate that visual red and yellow TCU of different recipes ranged between 0.92 to 1.15 and 5.53 to 6.96, respectively. The maximum (1.15) red TCU were recorded in T_1 which was statistically at par with T_5 and lowest (0.92) in T_4 and T_8. The highest (6.96) yellow TCU were recorded in T_4 and lowest (5.53) in recipe T_5.

Table 2: Physico-chemical characteristics of different recipes of wild aonla syrup

Treatments	Physico-chemical characteristics				
	Colour (TCU)		TSS (^oB)	Total phenols (mg/ g)	Ascorbic acid (mg/100 g)
	R	Y			
T_1	1.15	5.64	65.00	3.89	141.57
T_2	1.07	5.87	65.00	4.62	166.49
T_3	1.03	6.43	65.00	5.49	180.71
T_4	0.92	6.96	65.00	6.27	206.53
T_5	1.13	5.53	70.00	3.87	141.61
T_6	1.05	5.82	70.00	4.61	166.50
T_7	0.99	6.35	70.00	5.48	180.75
T_8	0.92	6.92	70.00	6.30	206.56
$CD_{0.05}$	0.03	0.09	-	0.69	1.48

TSS of first four recipes were maintained 65 ^oB and rest as 70 ^oB during the product preparation. The total phenols content of different recipes of syrup ranged between 3.87 to 6.30 mg/g. The highest (6.30 mg/ g) total phenols content was found in recipe T_8 which was statistically at par with T_4 and lowest (3.87 mg/ g) value in T_5 which was statistically at par with T_1. The ascorbic acid content of wild aonla syrup varied from 141.57 to 206.56 mg/ 100 g. The highest (206.56 mg/ 100 g) ascorbic acid content was recorded in T_8 which was statistically at par with T_4 and lowest (141.57 mg/100 g) in T_1 which was statistically at par with T_5.

Data presented in Table 2 show that recipe T_4 and T_8 had higher contents of total phenols and ascorbic acid, which might be due to the higher juice content used as compared to other recipes. Variation in the juice content of different recipes might have contributed toward the variations in the red and yellow (TCU) colour units of this product.

Sensory Characteristics

Data on sensory characteristics scores of different recipes of wild aonla syrup given in Table 3 indicate that the mean colour score was obtained highest (8.20) in T_4 which was statistically at par with T_1, T_3, T_5 and T_8 and lowest (7.02) in T_6 which was statistically at par with T_2 and T_7.

Table 3: Sensory characteristics (score) of different recipes of wild aonla syrup

Treatment	Colour	Body	Taste	Aroma	Overall acceptability
	7.70	6.89	6.50	7.46	6.37
	7.52	7.83	7.59	7.99	7.74
	8.15	8.00	8.31	8.12	8.10
	8.20	7.46	7.48	8.56	7.31
	8.01	6.80	6.56	7.56	6.57
	7.02	6.89	6.53	7.85	6.93
	7.53	7.54	7.92	7.31	7.01
	7.92	7.67	7.99	8.01	7.70
	0.56	0.50	0.62	0.54	0.89

The recipe (T_3) obtained maximum body score of 8.00 which was statistically at par with T_2, T_7 and T_8 and the lowest (6.80) score in T_5 which was statistically at par with T_1 and T_6. The highest (8.31) score of taste was awarded to same recipe which was statistically at par with T_7 and T_8 while T_1 got the lowest (6.50) score which was statistically at par with T_5 and T_6. The maximum (8.56) score for aroma was recorded in recipe T_4 which was statistically at par with T_3 and minimum (7.31) score in T_7 which was statistically at par with T_1, T_5 and T_6. The highest (8.10) score of overall acceptability was recorded in T_3 which was statistically at par with T_2, T_4 and T_8 and lowest (6.37) score in T_6 which was statistically at par with T_5, T_6 and T_7.

The higher colour, body and overall acceptability scores of recipe T_3 might be due to higher juice content and better combination of juice-acid-syrup blend as compared to other recipes, while same recipe T_3 obtained highest taste scores due to best combination of juice-syrup and sugar-acid-juice blend in this recipe which ultimately led the judges to award the highest scores to this recipe as compared to other. Nearly similar results have been reported by Thakur and Thakur (2017) [12] in box myrtle syrup. From the above results it was concluded that the recipe (T_3) with 35 per cent juice, 65 °B TSS and 1.80 per cent acidity was best on the basis of its some physico-chemical characteristics like colour, titratable acidity, ascorbic acid and sensory parameters like colour, body, taste, aroma and overall acceptability.

Physico-chemical and sensory characteristics of standardized recipe of syrup

Table 4: Physico-chemical and sensory characteristics of standardized recipe of wild aonla syrup

Characteristics		Mean values
Physico-chemical		
Colour (TCU)	Red	1.03 ± 0.01
	Yellow	6.43 ± 0.03
Apparent viscosity (sec)		307.60
TSS (°B)		65.00 ± 0.32
Reducing sugars (%)		44.28 ± 0.41
Total sugars (%)		61.98 ± 0.51
Titratable acidity (%)		1.80 ± 0.02
pH		3.08 ± 0.08
Ascorbic acid (mg/100 g)		180.71 ± 1.09
Total phenols (mg/ g)		5.49 ± 0.48
Sensory (Scores)		
Colour		8.15 ± 0.19
Body		8.00 ± 0.48
Taste		8.31 ± 0.36
Aroma		8.12 ± 0.27
Overall acceptability		8.10 ± 0.42

From the above table it was concluded that this standardized recipe of wild aonla syrup was best on the basis of its some physico-chemical characteristics like colour, titratable acidity, ascorbic acid and sensory parameters like colour, body, taste and overall acceptability. The mean highest scores for sensory characteristics like colour, body, taste, aroma and overall acceptability of this standardized recipe of wild aonla syrup were obtained as 8.15 ± 0.19, 8.00 ± 0.48, 8.31 ± 0.36, 8.12 ± 0.27 and 8.10 ± 0.42, respectively. Values of colour, total phenols and ascorbic acid obtained in this recipe were comparable to others. However, the maximum scores of sensory parameters of this recipe show its superiority over others because of best combination of juice and syrup, best sugar acid blend in the product. All these factors might have led the judges to award highest scores to this recipe.

Storage of wild aonla syrup

Physico-chemical characteristics

TSS and sugars

The TSS of syrup increased non-significantly during storage (Figure 1c) and this increase in TSS during storage might be due to hydrolysis of polysaccharides into monosaccharide and soluble disaccharides (Gould, 1983) [13]. Our results are in conformity with the findings of Reddy and Chikkasubbanna (2009) [14] in aonla syrup. Whereas, reducing and total sugars of syrup (Fig. 1d and 1e) also showed a significant increase during storage which might be due to hydrolysis of starch into sugars as well as conversion of complex polysaccharides into simple sugars and conversion of non-reducing to reducing sugars. More increase in these parameters was found in syrup stored under ambient conditions as compared to refrigerated storage conditions. As far as packaging material is concerned, more increase in TSS and sugars were recorded in syrup packed in PET bottles as compared to glass bottles. This might be due to the faster rate of chemical reactions in the product packed in PET bottle because of faster heat absorption of PET packaging material than glass. Similar results have been observed by Choudhary *et al.* (2012) [15] in aonla syrup and Hamid *et al.* (2017) [16] in mulberry syrup.

Colour, titratable acidity, ascorbic acid and total phenols

The decrease in red and yellow TCU (Figure 1a and 1b) of syrup was observed during storage. The reason for decrease in colour units of syrup during storage might also be due to browning caused by copolymerization of organic acids of the product. However, a non-significant decrease in titratable acidity of syrup was observed during storage, (Figure 1f) which might be due to co-polymerization of organic acids with sugars and amino acids. Ascorbic acid content of syrup decreased significantly during storage (Fig. 1g) which might be due to its degradation into dehydro-ascorbic acid or furfural during storage. Less decrease of ascorbic acid in refrigerated storage might be due to the slower rate of its degradation in low temperature as compared to ambient storage conditions because of its susceptibility to high temperature. Whereas, a significant decrease in phenols content of syrup was also recorded during storage (Fig. 1h) and this decrease in phenols content in syrup during storage might be due to their involvement in the formation of polymeric compounds by complexing with protein and their subsequent precipitations as observed by Abers and Wrolstad (1979) [17]. These reactions may be slower in refrigerated storage conditions and faster in ambient conditions during storage. As far as packaging material is concerned, more

retention of these parameters in syrup packed in glass bottle than PET bottle might be due to the difference in their thermal conductance properties which affect internal decomposition reactions. Similar trend of decreasing trend in these parameters have also been reported by Thakur and Thakur (2017) [12] in box myrtle syrup and Hamid *et al.* (2017) [16] in mulberry syrup.

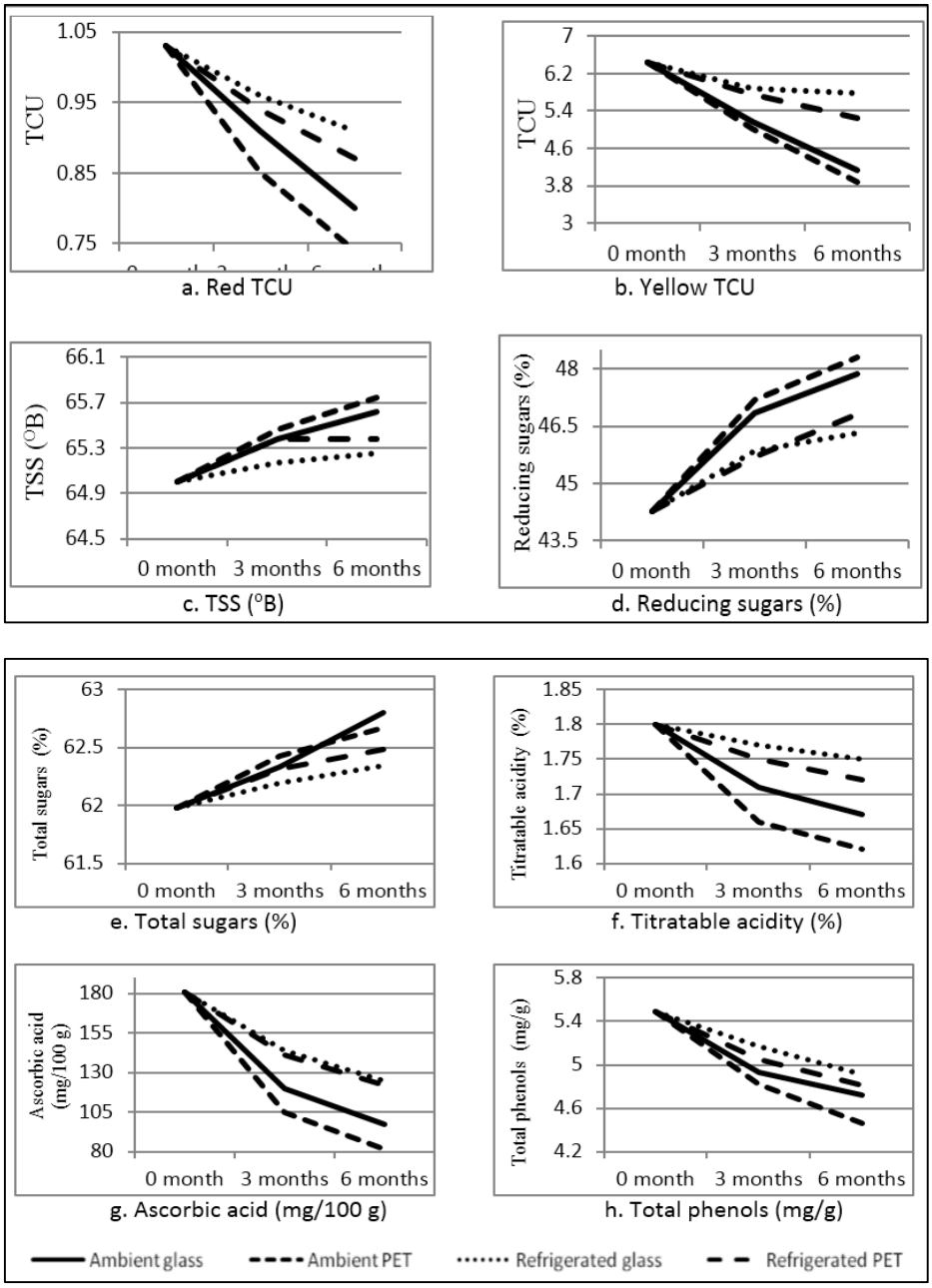

Fig 1: Effect of storage on physico-chemical characteristics of wild aonla syrup

Sensory characteristics of wild aonla syrup during storage

A decreasing trend in colour, body, taste, aroma and overall acceptability scores of syrup was observed during storage. However, decrease in sensory scores was less in refrigerated storage conditions (Fig. 2) than ambient (Fig. 3). The colour scores of syrup decreased significantly during storage which might be due browning caused by copolymerization of organic acids of the product. While, the possible reason for decrease in body scores was the formation of precipitates in the product as a result of interactions between phenols and protein as well as the formation of cation complexes with pectin and phenols during storage. The formation of precipitates in the product might have led the judges to award the lower scores. However, decrease in taste scores of product during storage might be due to loss of sugar-acid blend responsible for taste. Retention of higher taste scores in refrigerated conditions might be due to the better retention of original sugar-acid-salt blend as a result of slow reaction rate contributing change in this blend. However, the retention of better taste scores of syrup in glass bottle might be due to the better retention of sugar acid-blend as a result of slower reaction rate in glass bottle as compared to PET because glass absorb heat at slower rate than PET. The loss of aroma scores during storage might be due to the possible loss of volatile aromatic compounds which led the judges to award the lower scores. Decrease in overall acceptability scores might be due to the loss in appearance, flavour compounds and uniformity of the product during storage. Syrup packed in glass bottles retained more sensory scores than PET bottles. The retention of better overall sensory scores of syrup in glass bottles might

be due to the better retention of above given factors as a result of slower reaction rate in glass bottles as compared to PET. The similar results have also been reported earlier by Thakur and Thakur (2017) [12] in box myrtle syrup and Hamid *et al.* (2017) [16] in mulberry syrup.

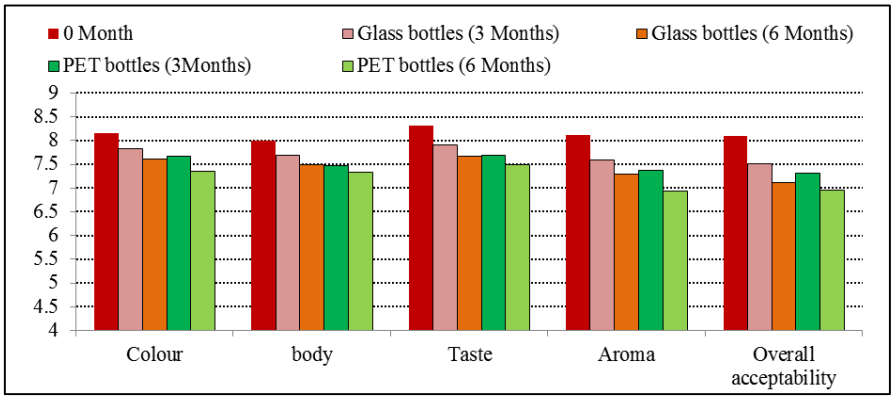

Fig 2: Effect of storage and packaging on sensory characteristics of wild aonla syrup stored under ambient conditions

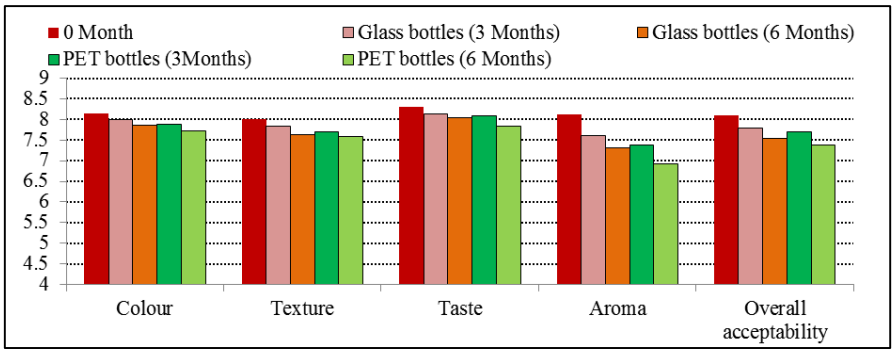

Fig 3: Effect of storage and packaging on sensory characteristics of wild aonla syrup stored under refrigerated conditions

Conclusion

Out of 8 different treatment combinations syrup recipe (T_3) containing 35 per cent juice, 65 °B TSS and 1.80 per cent acid was found to be best on the basis of its physico-chemical characteristics and sensory parameters. However, various quality characteristics like TSS (°B), reducing sugars (%), total sugars (%), apparent viscosity (sec) and pH of syrup increased slightly, while other chemical characteristics like titratable acidity (%), ascorbic acid (mg/100 g), total phenols (mg/100 g) decreased slightly during storage. Overall effect shows minimum decrease in sensory characteristics scores of colour, texture, taste, aroma, overall acceptability score from 8.15 to 7.64, 8.00 to 7.51, 8.31 to 7.76, 8.12 to 7.29, 8.10 to 7.25, respectively were observed during six months of storage. Syrup could be stored safely for a period of six months under both storage conditions and also in both packaging materials with minimum changes in chemical and sensory attributes. However, comparatively fewer changes in syrup packed in glass bottle and stored under refrigerated storage conditions were observed as compared to PET bottle.

References

1. Parmar C, Kaushal MK. Wild Fruit of Sub-Himalayan Region. Kalayani Publisher, New Delhi. 1982, 136.
2. Priya MD, Khatkar BS. Effect of processing method on keeping quality of aonla preserve. International Food Research Journal. 2013; 20(2):617- 622.
3. Nath V, Singh IS, Kumar S. Evaluation of aonla cultivars for their shelf-life at ambient temperature. Narendra Deva Journal of Agricultural Research. 1992; 7(1):117.
4. Ganachari A, Thangavel K, Mazara AS, Nidoni U, Ananthacharya. Physical properties of Aonla fruit relevant to the design of processing equipments. International Journal of Engineering Science and Technology. 2010; 2(12):7562-7566.
5. Radha T, Mathew L. Aonla In: Fruit Crops. K.V. Peter (eds.), Vol.3. New Delhi Publishing Agency, New Delhi. 2007, 287-301.
6. Pareek S, Kaushik RA. Effect of drying methods on quality of Indian gooseberry (*Emblica officinalis* Gaertn.) powder during storage. Journal of Scientific and Industrial Research. 2012; 71(11):727-732.
7. Bhattacharya A, Chatterjee A, Ghosal S, Bhattachaya KS. Antioxidant activity of active tannoid principles of *Emblica officinalis* (Amla). Indian Journal of Experimental Biology. 1999; 37:676-680.
8. Ranganna S. Handbook of analysis and quality control for fruit and vegetable products. Tata McGraw Hill, New Delhi. 2009, 1112.
9. Singleton VL, Rossi JA. Colorimetry of total phenolics with phosphomolybdic phosphotungstic acid reagent. American Journal of Enology and Viticulture. 1965; 16:144-158.
10. Amerine MA, Pangborn RM, Roessler EB. Principles of sensory evaluation of food. Academic Press, London. 1965, 236-268.
11. Mahony MO. Sensory evaluation of food: Statistical methods and procedures. Marcel Dekker, New York. 1985, 168-169.
12. Thakur A, Thakur NS. Development of Syrup from Box Myrtle (*Myrica nagi*) and its quality evaluation during storage. International Journal of Agriculture Sciences.

2017; 9(8):3862-3865.
13. Gould WA. Tomato production, processing and quality evaluation. 2nd ed. Avi Publishing Company, West port, CJ. 1983.
14. Reddy AH, Chikkasubbanna V. Studies on the storage behaviour of amla syrup. The Asian Journal of Horticulture. 2009; 4(1):5-9.
15. Choudhary ML, Verma IM, Singh J, Godara SL. Studies on biochemical changes in aonla (*Emblica officinalis* Gaertn.) syrup under storage condition. The Horticulture Journal. 2012; 25(1&2):7-11.
16. Hamid, Thakur NS, Kumar P, Thakur A. Development of Syrup from Mulberry (*Morus alba* L.) and its Quality Evaluation under Ambient and Refrigerated Storage Conditions. International Journal of Bio-resource and Stress Management. 2017; 8(1):116-121.
17. Abers JE, Wrolstad RE. Causative factors of colour determination in strawberry preserves during processing and storage. Journal of Food Science and Technology. 1979; 44:75.