Journal of Pharmacognosy and Phytochemistry
Available online at www.phytojournal.com

E-ISSN: 2278-4136
P-ISSN: 2349-8234
JPP 2018; 7(6): 74-77
Received: 11-09-2018
Accepted: 15-10-2018

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Studies on process standardization and storage behaviour of ready to serve (RTS) beverage prepared from aonla cultivars

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Abstract
Aonla fruits are highly nutritious and having good medicinal value but aonla fruits are not consumed freely in fresh form because of its astringent taste. Therefore, various cultivars of aonla were screened for their suitability into Ready to serve (RTS) beverage preparation, which may become a popular drink in comparison with modern synthetic beverages. Accordingly eight aonla cultivars viz - Banarasi, Chakaiya, Kanchan, Krishna, NA – 6, NA – 7, NA – 8, NA – 9 were evaluated. Fruits segments and water ratio of 1:1 was found ideal for pulp extraction. RTS of composition 10 per cent aonla pulp, 12 per cent Total soluble solids (TSS) and 0.2 per cent acidity were found ideal. During the storage in RTS Vitamin ‘C’ (ascorbic acid) content decreased while Total soluble solids increased. In RTS Acidity increased towards the end of storage whereas Browning increased continuously during storage. But organoleptic score of the RTS reduced gradually during storage and acceptable quality of RTS were maintained up to four months. Thus fruits of Chakaiya cultivar was found most suitable for making quality RTS.

Keywords: aonla, medicinal, products, storage, quality, ready to serve

Introduction
Aonla (*Emblica officinalis* Gaertn) occupies an important place among the indigenous fruits and it finds a special place in India as it has got tremendous medicinal value as well as high nutritional value also. Aonla fruit is one of the richest known sources of ascorbic acid (300-1000mg per 100g edible portion) depending upon the cultivar and location (Manny and Shadakshara Swamy, 1997) [10] and fresh fruit of aonla is also appreciable source of total sugar (7.53mg/100g), calcium (14.91mg/100g), iron (0.62 mg/100g), phosphorus (11.81 mg/100g) as reported by Khan (2009) [5]. Thereby, only a few fruits can meet the daily requirement of vitamin 'C' (Shankar, 1969) [16]. The fruit also contains polyphenols, which have antioxidant property and thus has good free radical scavenging activity. Tannin found in fruits containing gallic acid, ellagic acid and glucose in its molecule, which is naturally present in the fruit, prevents and/or retards the oxidation of the vitamin 'C'. Therefore, even after processing it retains major part of ascorbic acid.
Aonla fruits are not generally consumed fresh because fruits are highly acidic and astringent; therefore fruits are not popular as table fruit. Nayak *et al*. (2011) [12] reported that high medicinal properties of aonla fruits can be processed in to value added Ready to serve (RTS) beverage.
Keeping in view this fact, in present investigation an attempt has been made to evaluate Ready to serve (RTS), prepared from fruits of different aonla cultivars. Thus, aonla production may become a profitable enterprise.

Material and Methods
The study was carried out at Department of Horticulture, Janta College, Bakewar, Etawah (U.P.). Matured, uniform sized and disease free aonla fruits of each variety of eight cultivars viz. Banarasi, Chakaiya, Kanchan, Krishna, NA – 6, NA – 7, NA – 8, NA – 9 were selected and procured for RTS preparation from the experimental farm of Janta College, Bakwar, Etawah. The technique used for extraction of aonla fruit pulp is depicted in Flow chart -1.
Organoleptic quality of the RTS was evaluated by panel of 10 judges who scored on a 9-point Hedonic scale (Amerine *et al*., 1965) [1]. The recipe which has been found ideal for RTS was used for screening of cultivars.

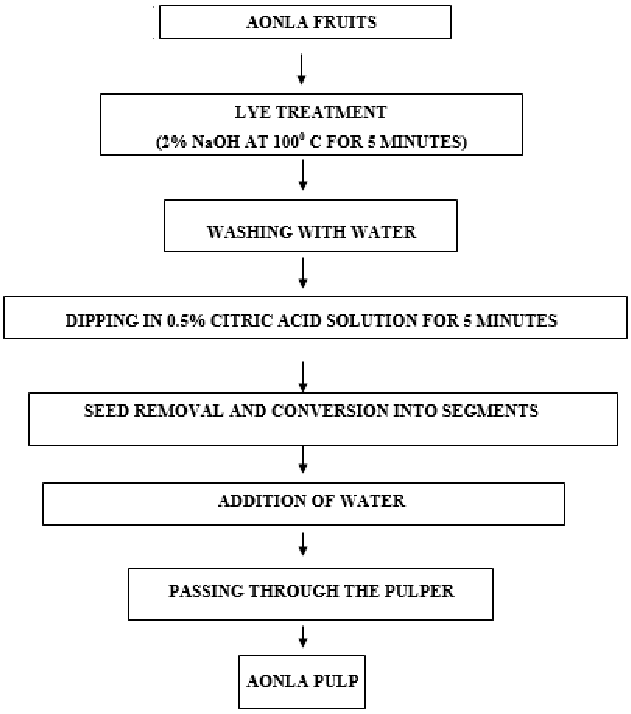

Chart 1: Flow chart for extraction of aonla fruit pulp

Technique used for preparation of aonla RTS (Ready-to-serve)

Recipe: 10 per cent aonla pulp having 12 per cent T.S.S. 0.25 per cent acidity.

Process: RTS was prepared by mixing calculated amount of pulp, sugar, citric acid and water followed by potassium metabisulphites. For formulation of recipe, the total soluble solids and acidity present in the pulp were first determined and remaining amount of sugar and citric acid was added after making adjustments for the ingredients already present. Sugar syrup was prepared by heating the mixture of sugar, water and citric acid. Syrup was strained with the help of muslin cloth and finally fruit pulp was blended with sugar syrup and mixture was then bottled, crown corked, pasteurized for 20 minutes in boiling water, cooled and stored for further studies.

The technique used for preparation of RTS is given in Flow chart- 2.

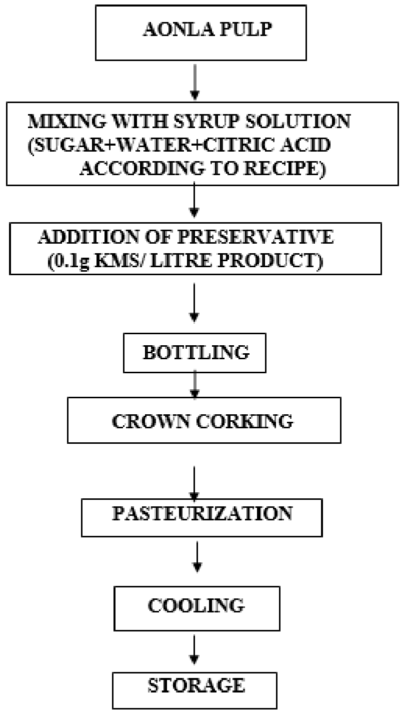

Chart 2: Technique used for preparation of aonla RTS.

Results

(A) Pulp extraction technique

Certain amount of water is required for the extraction of pulp in some fruits. In present finding, aonla pulp was successfully extracted by addition of water equal to the weight of segments. In other words, fruits segment and water ratio of 1:1 was found to be the optimum for easy extraction and better recovery of pulp with moderate total soluble solids, vitamin 'C' and acidity (Table-1). Addition of water for easy extraction of pulp has been also recommended in ber (Khuradiya and Singh, 1975) [8] and in bael (Roy and Singh, 1979) [14].

Table 1: Determination of fruit segment and water ratio for pulp extraction

Fruit segment/water ratio	Recovery of Pulp (%)	T.S.S. (%)	Vitamin C (mg/100g)	Acidity (%)	Organoleptic score
1:0.5	133.8	7.0	242.3	1.3	6.2
1:1.0	178.0	6.0	181.9	1.0	6.7
1:1.15	222.5	4.5	145.2	0.8	6.0
1:1.20	266.6	3.4	88.9	0.7	5.8
C.D. 5%	5.8	0.9	12.5	0.1	0.6

(B) Evaluation of recipe

(i) Qualitative changes during storage of RTS

The RTS was analysed for its vitamin 'C', TSS, acidity and browning content at an interval of one month and findings are given in Table 2. It is clear from Table-2 that in RTS vitamin 'C' (ascorbic acid) content decrease with increasing storage period. When RTS was prepared it was having 52.31 mg vitamin 'C' per 100g, which ultimately came down to 20.19 mg after nine months of storage and the retention was 38.60 per cent. Where as in the beginning it was 12.00 per cent in RTS, which reached to 16 per cent after 9 months of storage. Acidity content of the RTS not change up to one month thereafter changes were recorded after each storage period slab. At the time of preparation of RTS it was having 0.25 per cent acidity, which reached, to a level of 0.37 per cent after nine month. Browning observation of RTS was measured at 440 nm (nanometer) using 60 per cent alcohol as blank. Browning in terms of O.D. increased continuously during storage of RTS. In RTS, it was registered an increase of 950 per cent.

Table 2: Qualitative changes during storage of RTS

Storage Period (Month)	Qualitative Changes During Storage of RTS									
	vitamin 'C'		TSS		Acidity (%)		Browning		Organoleptic	
	Quantity	Retention	Quantity (mg/100g)	Increase/ Decrease (%)	Quantity (mg/100g)	Increase/ Decrease (%)	Quantity (OD)	Increase/ Decrease (%)	Score	Rating
0	52.31	100.00	12.0	00.00	0.25	00	0.02	00	8.0	LM
1	50.90	97.30	12.3	+2.50	0.25	00	0.03	50	8.0	LM
2	48.38	92.49	12.7	+5.83	0.28	+12	0.05	150	7.3	LM
3	46.65	89.12	13.0	+8.33	0.30	+20	0.07	250	7.3	LM
4	41.37	79.09	13.5	+12.50	0.31	+24	0.09	350	7.1	LM
5	38.09	72.82	14.0	+16.67	0.33	+32	0.10	400	6.8	LS
6	36.36	69.51	14.6	+21.67	0.34	+36	0.12	500	6.5	LS
7	30.73	58.10	15.0	+25.00	0.35	+40	0.15	650	6.5	LS
8	25.39	48.54	15.4	+28.33	0.36	+44	0.17	750	6.0	LS
9	20.19	38.60	16.0	+33.33	0.37	+48	0.19	850	6.5	LS

Quantity-mg/100g
Retention-%

(ii) Organoleptic evaluation

The organoleptic quality of RTS was judged by a panel of judges and the product was assessed on the basis of color, appearance, texture and taste and the overall average (Table 3). It is clear that organoleptic score of RTS decreased with the storage period up to four months of storage.

Table 3: Organoleptic quality of RTS prepared from aonla cultivars.

Cultivars	Organoleptic quality	
	Score	Rating
Banarasi	7.0	Like moderately
Chakaiya	8.0	Like very much
Kanchan	7.0	Like moderately
Krishna	7.2	Like moderately
NA-6	7.4	Like moderately
NA-7	6.3	Like slightly
NA-8	6.5	Like slightly
NA-9	7.3	Like moderately
C.D. at 5%	0.5	

The data presented in Table -3 is evident that organoleptic quality of RTS prepared from Chakaiya cultivars was best (8.0) among RTS prepared from other cultivars. The difference was in RTS score was non significant among Banarasi (7.0), Kanchan (7.0), Krishna (7.2), NA-6 (7.4), and NA-9 (7.3) cultivars. The RTS prepared from NA-7 (6.3) and NA-8 (6.5) cultivars did not show the acceptable score.

Discussion

The variability studies indicated the possibility of selecting an ideal cultivar for processing industries to prepare RTS. Chakaiya cultivar had showed better suitability for becoming popular cultivar for processing industry. Results of present studies indicate that the vitamin 'C" content of R.T.S. decreased continuously with the increasing storage period. The result corroborate with findings of Singh *et al*. (1993) [18] who also recoded loss of ascorbic acid during storage of aonla. Reduction in vitamin 'C' may be due to oxidation by trapped oxygen in container, which results in formation of dehydro ascorbic acid. Loss of ascorbic acid was also observed in aonla RTS and squash (Ram, 1984) [13].

Total soluble solids of RTS increased slightly during storage. Hydrolysis of polysaccharides during storage of beverages (RTS) may be the possible reason for little increase in total soluble solids. An increase in total soluble solids in aonla beverages was also reported by Ram (1984) [13]. Similarly increase in total soluble solids during storage of guava RTS (Singh, 1985) [17], jamun squash (Ashraf, 1987) [2] and papaya beverages (Kumar, 1990) were also noticed. This finding is also supported by Ram (1984) [13]. Similar results have also been observed phalsa beverages (Khurdiya, 1979) [6] and (Sabahuddin *et al*., 2017) [15].

A progressive increase in browning of aonla RTS was observed with the storage period in present findings. This could be mainly due to the non-enzymatic reaction such as ascorbic acid with sugar or oxidation of phenols, which leads to the formation of brown pigments. A significant difference in intensity of browning was noticed variability in browning among different fruit products is caused by three types of general reaction, i.e., (i) nitrogenous compound and sugar, (ii) organic acids and sugar, (iii) nitrogenous compound and organic acid. Factor accounted for browning of fruit products are ascorbic acid, temperature, oxygen, moisture, and sulphur dioxide treatment and these factors are interrelated. Stadman (1948) [20] reported that decline in ascorbic acid content of fruit products may be one of the possible reasons for browning of the products. The present findings get support with work on aonla beverages (Ram, 1984) [13]. Diemair and Jury (1965) [3] reported 5-hydroxymethyl, 2-furfuraldehyde is produced in fruit juice from sugar particularly ketones by heating during processing and can cause browning reaction with amino compounds and sugars. Meyer (1987) [11] has suggested three hypotheses to explain non-enzymatic browning (i) browning reaction, which occurs between carbohydrates and amino acids, results in the formation of brown pigment known as ''Mailard reaction'' and believed by many to explain the browning found in processed fruits, (ii) oxidation of ascorbic acid leads to the formation of brown pigments, and (iii) carbohydrates or carbohydrate and acid decomposes to furfuraldehyde or related compounds, which then polymerise or react with nitrogen compounds to form brown pigments.

Organoleptic score of the aonla beverages (RTS) declined continuously during storage. Singh (1999) [19] also reported continuous decrease in organoleptic rating of RTS. The acceptable quality of aonla beverages (RTS) was maintained up to four months. Temperature is the most single factor affecting the uptake of oxygen; the rate increases nearly 4 times for every 10 ^{0}C rise in temperature. Sulphur compounds present in fruit juice mainly in three forms viz., amino acid of protein and volatile compound and sulphate preservation of fruit beverages by addition of SO_2 delayed or reduced the browning. Temperature plays an important role in inducing certain biochemical changes in the products, which leads to development of off flavour as well as discoloration and thus masking the original colour and flavour of products. Reduction in organoleptic quality has also observed in aonla beverages, phalsa beverages (Khurdiya and Anand, 1981) [7] and Gaikwad *et al*. (2013) [4].

Conclusions

On the basis of observations recorded on various qualitative changes and organoleptic quality of RTS during storage. Fruits segments and water ratio of 1:1 was found ideal for pulp extraction. RTS of composition 10 per cent aonla pulp, 12 per cent Total soluble solids (TSS) and 0.2 per cent acidity were found ideal. During the storage in RTS Vitamin 'C' (ascorbic acid) content decreased while Total soluble solids increased. In RTS Acidity increased towards the end of storage whereas Browning increased continuously during storage. But organoleptic score of the RTS reduced gradually during storage and acceptable quality of RTS were maintained up to four months. Thus fruits of Chakaiya cultivar were found most suitable for making quality RTS beverage.

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