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Standardization process and storage behaviour of fruit beverages (RTS and squash) prepared from fruits of aonla cultivars

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ABSTRACT : Aonla is an important fruit grows widely in Uttar Pradesh and other tropical and subtropical regions of India. Generally, aonla fruits considered as "Wonder Fruit for the Health" because fruits are highly nutritious and having good medicinal value but fruits are not consumed freely in fresh form because of its astringent taste. Therefore, various cultivars of aonla were screened for their suitability into fruit beverages like Ready to serve (RTS) squash 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% Total soluble solids (TSS) and 0.2% acidity were found ideal. Composition of squash with 25% aonla pulp, 50% Total soluble solids (TSS) and 1% acidity were found ideal. During the storage in RTS and squash Vitamin 'C' (ascorbic acid) content decreased while Total soluble solids increased. In RTS and Squash acidity increased towards the end of storage whereas Browning increased continuously during storage. But organoleptic score of the RTS and Squash 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 and Squash, which may helpful in making aonla production a profitable enterprise in India.

Key Words : Aonla (*Emblica officinalis* Gaertn.) products, storage, quality, ready to serve (RTS), squash.

Aonla (*Emblica officinalis* Gaertn.), the fruit has high medicinal and nutritional value and 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) Aonla fruits are not consumed freely in fresh form because of its astringent taste. Therefore, it is not popular as a desert fruit. So, there is urgent need for their value addition. In tropical countries like India, fruit beverages are becoming increasingly popular in comparison with synthetic beverages/drinks. Processing of fruit into quality beverages (RTS and Squash) would be more nutritious than aerated products available in the market and are being sold in large quantity in our country. In order to ensure the aonla production a profitable enterprise, there is dire need to explore possibility of utilizing the aonla fruits for processing industry.

Keeping in view this fact, in present investigation an attempt has been made to evaluate fruit beverages (RTS and Squash), prepared from fruits of different aonla cultivars. Thereby, aonla production may become a profitable enterprise in the India.

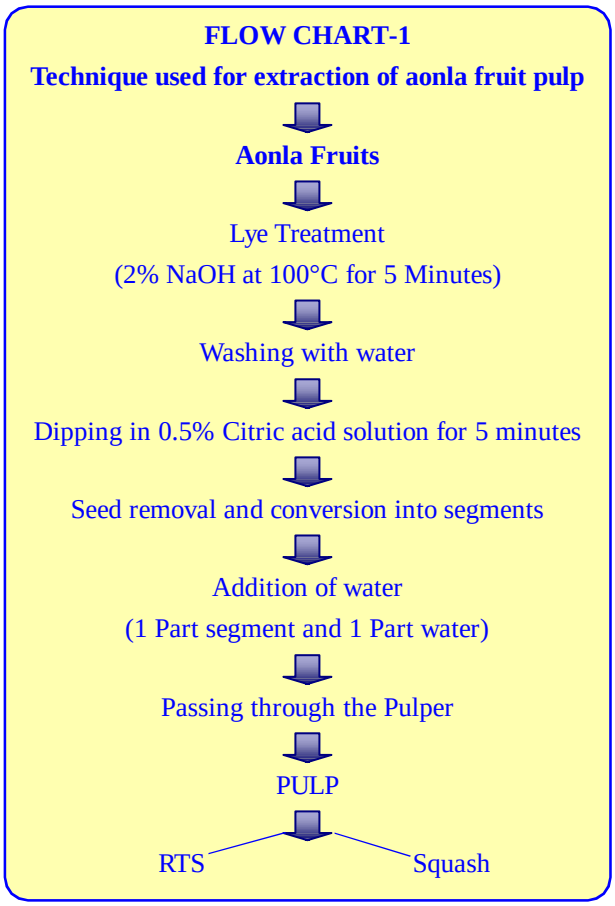
Materials and Methods

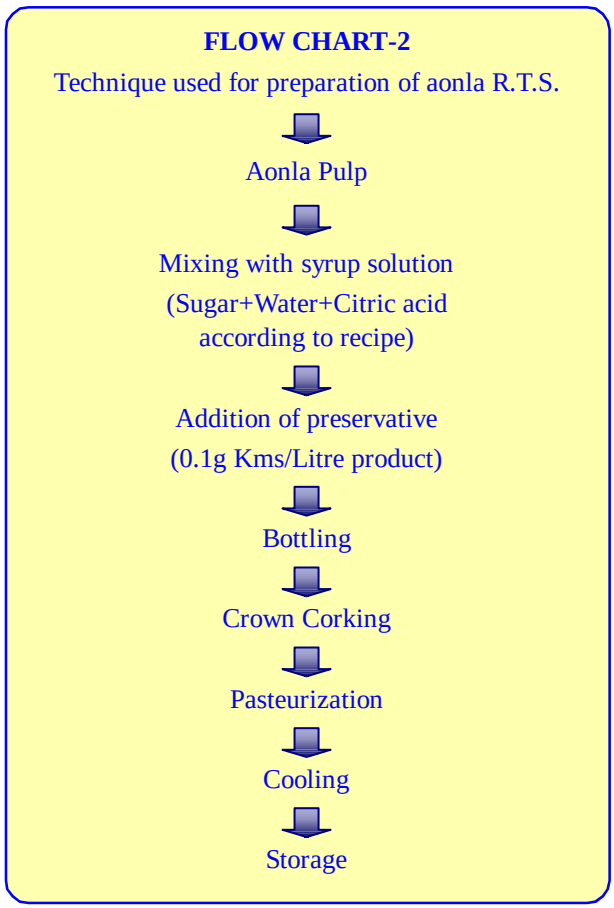
The study was carried out at Department of Horticulture, Janta College, Bakewar, Etawah (U.P.). Matured, uniform sized and disease free aonla fruits of each variety of eight cultivars viz. Banarasi, Chakaiya, Kanchan, Krishna, NA–6, NA–7, NA–8, NA–9 were selected and procured for fruit beverages (RTS and Squash), 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 fruit beverages (RTS and Squash) was evaluated by panel of 10 judges who scored on a 9-point Hedonic scale (Amerine *et al.*, 1965) as mentioned below:

Organoleptic score	Rating
9	Like extremely (LE)
8	Like very much (LVM)
7	Like moderately (LM)
6	Like slightly (LS)
5	Neither like nor disliked (NLND)
4	Dislike slightly (DS)
3	Dislike moderately (DM)
2	Dislike very much (DVM)
1	Dislike extremely (DE)

Overall the final rating was obtained by averaging the marks given by judges. The recipe which has been found ideal for fruit beverages (RTS and Squash) was





used for screening of cultivars.

Technique used for preparation of fruit beverages (RTS and Squash)

(a) 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.

(b) Squash

Recipe: 25 per cent aonla pulp, 50 per cent T.S.S. and 1 per cent acidity.

Process: Squash was prepared by mixing calculated amount of pulp, sugar, water, and citric acid followed by preservative. 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 water, sugar and citric acid. Syrup strained with the help of muslin cloth and finally fruit pulp was blended with sugar syrup then bottled, capped and stored for further studies. The technique used for preparation of squash is given in Flow chart-3.

Results and Discussion

(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 opti-

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

FLOW CHART-3

Technique used for preparation of aonla squash.

Aonla Pulp

↓

Mixing with syrup solution
(Sugar + Water + Citric Acid
according to recipe)

↓

Addition of preservative
(0.6 g Kms/ Litre Product)

↓

Bottling

↓

Capping

↓

Storage

mum 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) and in bael (Roy and Singh,1979)

(B) Evaluation of recipe

(i) Qualitative changes during storage of RTS

The RTS was analyzed 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. Whereas 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 months. 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.

(ii) Qualitative changes during storage of squash

The squash was analyzed for its vitamin 'C', TSS, acidity and browning content at an interval of one month and findings are given in Table 3. It is clear from Table-2 that in squash vitamin 'C' (ascorbic acid) content decrease with increasing storage period. When squash was prepared maximum vitamin 'C' contend was noted it was 175.30 mg per 100g, gradually it came down to 39.10 mg per 100g after nine months of storage and the retention was lowest (22.30 per cent). TSS content in squash was also observed increase with increasing storage period. In beginning it was 50.0 mg per 100g, which reached 52.3 mg per 100g after 9 months of storage. This increase was 104.6 per cent. Acidity content of the squash did not change up to one month thereafter changes were recorded after each storage period slab. At the beginning of storage of squash acidity was 1.00 per cent, which become 1.50 percent after nine months. This increase was continuously and showed 150 per cent increase. The observation of Browning in all samples of squash was measured at 440 nm (nanometer) using 60 per cent alcohol as blank. Browning in terms of O.D. increased continuously during storage of squash and highest increase was recorded 1600 per cent. In the beginning of squash storage Organoleptic score was 8 in first month, which decreased

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**Rating**	+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-%

Table-3 : Qualitative changes during storage of squash.

Storage Period (Month)	Qualitative Changes during Storage of Squash									
	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	175.30	100.00	50.0	100.0	1.00	100	0.01	100	8.0	LVM
1	158.20	90.25	50.2	100.4	1.10	110	0.02	200	8.0	LVM
2	142.20	81.12	50.4	100.8	1.15	115	0.04	400	7.8	LM
3	127.70	72.85	50.8	101.6	1.21	121	0.05	500	7.7	LM
4	109.90	62.69	51.1	102.2	1.25	125	0.07	700	7.5	LM
5	98.70	56.30	51.3	102.6	1.30	130	0.09	900	6.8	LS
6	76.90	43.87	51.5	103.0	1.34	134	0.11	1100	6.5	LS
7	62.50	35.65	51.8	103.6	1.40	140	0.14	1400	6.5	LS
8	51.20	29.21	52.0	104.0	1.44	144	0.16	1600	6.2	LS
9	39.10	22.30	52.3	104.6	1.50	150	0.16	1600	3.5	LS

continuously and reached 3.5 in ninth months

(iii) Organoleptic Evaluation of RTS

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-4).

It is clear that organoleptic score of RTS decreased with the storage period up to four months of storage.

Table-4: 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.

(vi) Organoleptic Evaluation of Squash

Organoleptic quality of squash was judged by a panel of judges and rating obtained is given in Table-5.

Table–5: Organoleptic quality of Squash prepared from aonla cultivars.

Cultivars	Organoleptic quality	
	Score	**Rating**
Banarasi	7.1	Like moderately
Chakaiya	8.0	Like very much
Kanchan	7.0	Like moderately
Krishna	7.2	Like moderately
NA-6	7.3	Like moderately
NA-7	6.5	Like slightly
NA-8	6.3	Like slightly
NA-9	7.4	Like moderately
C.D. at 5%	0.5	

Data furnished in Table-4 and their statistical analysis presented in Appendix-3 (ii) it is evident that organoleptic score of squash prepared from different cultivars differed significantly. The squash-prepared from Chakaiya cultivar recorded highest organoleptic score (8.0) followed by NA-9 (7.4) and NA-6 (7.3). The organoleptic score of squash prepared from Banarasi (7.1), Kanchan (7.0), Krishna (7.2), NA-6 (7.3), and NA-9 (7.4) cultivars of aonla did not significantly. The squash prepared from NA-7 (6.5) and NA-8 (6.3) did not show the acceptable score.

The variability studies indicated the possibility of selecting an ideal cultivar for processing industries to prepare fruit beverages (RTS and Squash). 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) who also recorded 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) and in tomato (Srivastava *et al*., 2014).

Total soluble solids of RTS and Squash increased slightly during storage. Hydrolysis of polysaccharides during storage of beverages (RTS and Squash) 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). Similarly increase in total soluble solids during storage of guava RTS and Squash (Singh, 1985), jamun squash (Ashraf, 1987) and papaya beverages (Kumar, 1990) were also noticed. This finding is also supported by Ram (1984). Similar results have also been observed phalsa beverages (Khurdiya, 1979) and (Sabahuddin *et al*., 2017). Acidity content has been observed increase in beverage squash continuously. This finding is also supported by Ram (1984). Similar results have also been observed in bael squash (Dube, 1984) and phalsa beverages (Khurdiya, 1979).

A progressive increase in browning of aonla RTS and Sqaush 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) 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). Diemair and Jury (1965) 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) 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 and Squash) declined continuously during storage. Singh (1999) also reported continuous decrease in organoleptic rating of RTS and Squash. The acceptable quality of aonla beverages (RTS and Squash) was maintained up to four months. Oxygen absorbed by the product during processing may lead to darkening. Although browning may also occurred in some product under anaerobic condition. Temperature is the most single factor affecting the uptake of oxygen; the rate increases nearly 4 times for every 10°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), Gaikwad *et al*. (2013) and Jairajpuri *et al*. (2016).

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. squash of composition 25 per cent aonla pulp, 50 per cent Total soluble solids (TSS) and 1 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 in Squash did not change up to one month thereafter changes were recorded after each storage period slab. Browning increased continuously during storage. But organoleptic score of the RTS and Aquash 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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