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Suitability of aonla (*Emblica officinalis*) cultivars for development of osmo air dried slices

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ABSTRACT

The present study was undertaken to find out most suitable cultivar of aonla *(Emblica officinalis* Gaertn.*)* for development of value added products, i.e. osmo-air dried slices from four aonla cultivars, viz. Banarasi, Chakaiya, NA7 and Desi. The osmo air dried slices were prepared using sugar syrup of 70^0 Brix, citric acid for 24 hrs and dried at 60^0C. The slices were packed in polythene pouches and stored at ambient conditions to observe the effect of storage on quality and shelf life. The prepared samples were analysed for various quality parameters. An increasing trend was observed in the acidity, where as total sugars, reducing sugars, water activity and ascorbic acid content showed a decreasing trend in all the four cultivars. The highest acidity (4.68 %) was found in Desi cultivar, whereas the highest total sugars and reducing sugar (43.42 %, 33.02 %, respectively) were recorded in Chakaiya after 135 days of storage. The acceptability of the product was evaluated in terms of colour, flavour, taste and overall acceptability. The highest mean score for colour (7.12), texture (7.59), flavour (7.68) and overall acceptability (7.43) was found in Chakaiya followed by Banarasi cultivar. Thus, both Chakaiya and Banarasi were found to be suitable cultivars for making of osmo air dried slices.

Key words: Aonla, Banarasi,Chakaiya, NA 7, Osmo-air dried

Aonla or Indian gooseberry (*Emblica officinalis* Gaertn.) is one of the medicinal fruit tree of commercial significance. The fruit is highly nutritive and rich source of ascorbic acid, pectin and tannins, but unfortunately they are bound by seasonality. The high level of ascorbic acid makes it good as an antiscorbutic, diuretic, laxative and antibiotic. The fruit is also reported to possess pronounced expectorant, antiviral and cardiotonic activities. It also possesses hypoglycemic activity (Mehta 1995). Moreover, the fresh aonla fruit is highly acidic and astringent, therefore, it is not palatable for direct consumption but it has great potential in processed form. Further, the storability after harvesting is a limitation due to its high perishable nature.

Various methods for extending the shelf-life of aonla includes cold storage, sun drying, hot air drying, or by processing into preserve, pickle, juices, syrups, squash, jelly powder etc. (Nath and Sharma 1988) and dehydrated powder (Kalra 1988). Among all these processes, dehydration offers many advantages such as reduced weight, inexpensive packaging and negligible deterioration in quality due to enzymatic change. Osmo dehydration is a process of partial removal of water by soaking foods, mostly fruits and vegetables in hypertonic solution (Shi and Maguer 2002). The food which has been osmotically dehydrated can further be processed by freezing, freeze drying, vaccum drying and air drying. So far, only limited efforts have been made to process aonla into dehydrated products (Palodkar *et al*. 2003).

Hence, considering scope of drying techniques in fruits, the present investigation was undertaken to study the suitability of aonla cultivars for osmo air dried slices.

MATERIALS AND METHODS

Fresh fruits of four aonla cultivars, viz. Banarasi, Chakaiya, NA-7 and Desi were procured from Akhnoor and Regional Research Station for Sub-tropical Fruits, Raya, SKUAST-Jammu. The fruits were washed under running tap water to remove the adhering dirt and dust and analysed for physico-chemical parameters. Osmo air dried slices of aonla were prepared by using blanched aonla segments submerged in 70 per cent concentration sugar syrup (containing water sugar and citric acid) for overnight. These segments were removed from syrup, drained for half an

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Table 1 Physico-chemical characteristics of different cultivars of aonla

Parameter	Banarasi	Chakaiya	NA-7	Desi	CD (P=0.05)
Average fruit weight (g)	30.21	26.64	27.34	15.63	3.24
Average fruit length (cm)	3.40	3.10	3.22	2.41	0.16
Average diameter (cm)	4.14	3.88	3.90	3.12	0.21
Seed pulp ratio (%)	1.23	1.18	1.21	1.14	NS
Moisture (%)	86.90	86.16	86.40	82.10	NS
TSS(°B)	12.2	8.1	11.8	13.7	1.21
Acidity (%)	2.33	2.18	2.20	2.55	NS
Total sugar (%)	8.03	9.62	8.21	7.13	0.86
Reducing sugar (%)	1.07	2.01	1.08	1.06	0.42
Pectin (%)	0.53	0.50	0.51	0.47	NS
Ascorbic acid (mg/100g)	647	627	604	486	4.56

hour on stainless steel sieve and dried at 60^0 C for a day. The processed samples were packed and sealed in polythene bags. The products were stored at ambient temperature (30 + 2^0 C) for 135 days. The biochemical parameters, viz. titratable acidity, total sugars, reducing sugars and ascorbic acid were determined as per standard procedure (Ranganna 2002). The water activity was determined on Aqua Lab 3TE equipment. The developed products were also assessed for organoleptic rating on 9 point Hedonic scale (Murray *et al*. 2001). The data was analysed statistically by factorial completely randomized design and reported at 5 per cent significance level (Panse and Sukhatme 1985).

RESULTS AND DISCUSSION

Among all the four aonla cultivars, Banarasi showed maximum fruit weight (30.21 g), average diameter (4.1 cm) and seed pulp ratio (1:1.23 per cent), followed by NA 7 and Chakaiya having fruit weight of (27.34 g) and (26.64 g), average diameter (3.9 cm) and (3.8 cm) and seed pulp ratio (1: 1.20) and (1: 1.18 per cent), respectively (Table 1). Similar findings were reported in Banarasi by Singh and Arora (1967) while comparing two varieties of aonla, viz. Banarasi and Chakaiya. Desi cultivar had minimum weight and average diameter. Banarasi had maximum moisture content (86.90 per cent), whereas the same was recorded as 86.40, 86.14 and 82.10 per cent in NA-7, Chakaiya and Desi, respectively. Similar findings have been reported by (Singh and Arora, 1967) for moisture content in Chakaiya and Desi cultivar.

Among four studied cultivars, Desi had maximum total soluble solids (TSS) 13.7^0B, followed by Banarasi (12.2^0B); NA7 (11.8^0B) and Chakaiya (8.1^0B) (Table 1). Highest TSS 15.2^0B has also been reported by Teaotia *et al*. (1968) in Desi aonla. The maximum acidity was found in Desi cultivar followed by Banarasi, NA7 and Chakaiya. Singh and Arora (1967) have also reported the highest acidity in Banarasi when compared with Chakaiya aonla cultivar. Total sugars and reducing sugar percentage were found to be the highest in Chakaiya (9.62 and 2.01, respectively) followed by (8.2 and 1.08) in NA7, (8.03 and 1.07) in Banarasi and (7.13 and 1.06) in Desi, respectively. Similar findings have been reported for Chakaiya cultivar (Teaotia *et al.* 1968, Singh *et al*. 1987). Pectin content was found higher in Banarasi 0.53 per cent followed by NA7, Chakaiya and Desi 0.51, 0.50 and 0.47 per cent, respectively.

The maximum ascorbic acid content of 647mg/100g fruit weight was found in Banarasi followed by Chakaiya (627 mg/100g), NA-7 (640 mg/100g) and Desi (486 mg/100g) (Table 1). These findings were quite similar with Singh and Arora (1967) in Banarasi cultivar followed by Chakaiya. These results are also in accordance with Singh *et al*. (1984) who stated that Banarasi aonla contained more ascorbic acid (645.5 mg/100g) than Desi (540.7 mg/100g). It has been found that ascorbic acid content of the fruit varies directly with the fruit weight. Banarasi variety was found higher in fruit weight and thus recorded maximum ascorbic acid (Singh *et al*. 1987).

The biochemical parameters analysed in osmo air dried slices are depicted in Table 2 and 3. The data in the Table 2 revealed that there was significant increase in the acidity

Table 2 Effect of storage period and cultivars on acidity (%), total sugar and reducing sugar (%) of osmo air dried aonla slices

Cultivar	Acidity (%) (days)					Total sugar (%) (days)					Reducing sugar (%) (days)				
	0	45	90	135	Mean	0	45	90	135	Mean	0	45	90	135	Mean
Banarasi	3.64	3.68	3.92	3.97	3.80	43.34	43.11	42.71	42.38	42.88	37.45	35.24	32.06	31.12	33.97
Chakaiya	3.32	3.37	3.67	3.72	3.52	44.24	44.07	43.78	43.42	43.87	38.09	36.07	34.52	33.02	35.42
NA-7	3.56	3.59	3.88	3.94	3.74	43.42	43.22	42.83	42.43	42.97	37.62	34.98	33.07	31.58	34.31
Desi	4.19	4.22	4.63	4.68	4.43	41.05	40.87	40.42	40.13	40.62	37.24	34.52	32.19	31.02	33.74
Mean	3.67	3.71	4.02	4.08		43.01	42.82	42.43	42.09		37.60	35.20	32.96	31.68	
Factor		*CD*	*SE(d)*	*SE(m)*			*CD*	*SE(d)*	*SE(m)*			*CD*	*SE(d)*	*SE(m)*	
Day		0.014	0.007	0.005			0.01	0.005	0.004			0.15	0.007	0.005	
Cultivar		0.014	0.007	0.005			0.01	0.005	0.004			0.15	0.007	0.005	
Day × Cultivar		0.029	0.014	0.010			0.02	0.011	0.008			0.03	0.014	0.010	

Table 3 Effect of storage period and cultivars on ascorbic acid (mg/100g) and water activity (a_w) of osmo air dried aonla slices.

Cultivar	Ascorbic acid (mg/100g) (Days)					Water activity (a_w) (Days)				
	0	45	90	135	Mean	0	45	90	135	Mean
Banarasi	266.64	246.62	220.16	207.41	235.21	0.596	0.532	0.517	0.412	0.514
Chakaiya	254.13	242.16	218.43	204.52	229.81	0.587	0.543	0.517	0.419	0.517
NA-7	259.47	240.12	216.72	202.31	229.65	0.591	0.532	0.509	0.455	0.522
Desi	196.47	172.32	153.14	141.30	165.81	0.682	0.662	0.651	0.524	0.630
Mean	244.17	225.30	202.11	188.88		0.614	0.567	0.549	0.453	
Factor		*CD*	*SE(d)*	*SE(m)*			*CD*	*SE(d)*	*SE(m)*	
Day		0.01	0.01	0.004			0.001	0.0003	0.0003	
Cultivar		0.01	0.01	0.004			0.001	0.0003	0.0003	
Day × Cultivar		0.03	0.01	0.009			0.001	0.001	0.001	

from the initial day to 135 days of storage. The mean acidity of 3.67 per cent was recorded at zero day of storage whereas, the highest mean acidity value of 4.08 per cent was recorded after 135 days of storage period. Osmo air dried slices prepared from Desi cultivar recorded maximum acidity 4.19 per cent at initial day and 4.68 per cent after 135 days of storage. The increase in acidity might have been due to formation of acid, owing to inter conversion of sugars and other chemical reactions which are accelerated at high ambient temperature (Rao and Roy 1980). Also, deesterification of pectin molecules occurs during storage resulting in the loss of jelly grade which leads to gradual decrease in methoxyl content and increase in titratable acidity. Similar trends have been reported in dehydrated mango pulp and dates (Kumar 1989).

Table 2 revealed that total sugar contents of osmo air dried slices of aonla decreased during the entire storage period from initial mean value of 43.01 to 42.09 per cent. The decrease in total sugars might be due to non-specific hydrolysis of macromolecules, interconversion of sugars and aggregation of monomers during storage. A steady decline in total sugar content in direct solar dried Banarasi aonla at 90 days of storage had also been reported (Patter 1985). A similar trend in Desi and Banarasi cultivars of aonla has also been found (Ghorai and Sethi 1996). The data pertaining to reducing sugar content (Table 2) depicted a significant decrease, with the advancement of storage period from initial mean value of 37.60 to 31.68 per cent. The decrease in reducing sugar with storage might be due to dehydration reactions causing sugars to become unsaturated and highly reactive. The hexose reducing sugars are partially converted to 2-furaldehyde and 5-hydroxy methyl-2-furaldehyde (Fenneme 1985).

The ascorbic acid content in osmo air dried aonla slices was significantly reduced in all four cultivars during 135 days of storage (Table 3). The mean ascorbic acid content decreased from its mean initial value of 244.17 mg/100g to 188.80 mg/100g. The decline in ascorbic acid content might be due to oxidation by trapped oxygen in polyethylene bags which might have resulted in formation of dehydro ascorbic acid (Kumar *et al*. 1992). Ascorbic acid content of papaya products have also been reported to decrease continuously (Kumar 1990). Similar findings have been reported in osmo air dried pineapple (Rashmi *et al*. 2005) and aonla products (Deen 1992) during storage. There was significant decrease in water activity of the osmo air dried slices of aonla with advancement of storage period (Table 3). The highest mean water activity content of 0.607 was recorded at initial day and lowest value of 0.447 was recorded after 135 days of storage. Similar findings have

Table 4 Effect of storage and cultivars on colour and texture of osmo air dried aonla slices.

Cultivar	Colour (Days)					Texture (Days)					Flavour (Days)				
	0	45	90	135	Mean	0	45	90	135	Mean	0	45	90	135	Mean
Banarasi	8.10	8.02	7.49	6.82	7.61	7.87	7.68	7.61	7.20	7.59	7.84	7.61	7.43	6.80	33.97
Chakaiya	8.13	8.06	7.63	7.12	7.73	7.91	7.81	7.62	7.31	7.66	8.10	8.10	7.64	6.91	35.42
NA 7	7.77	7.04	6.53	6.04	6.84	7.60	7.41	7.21	7.21	7.35	7.72	7.50	7.20	6.71	34.31
Desi	7.20	7.12	6.40	6.02	6.68	7.21	7.01	6.81	6.81	6.96	7.43	7.20	6.82	6.64	33.74
Mean	7.80	7.56	7.01	6.50		7.64	7.48	7.31	7.13		7.77	7.60	7.27	6.76	
Factor		*CD*	*SE(d)*	*SE(m)*			*CD*	*SE(d)*	*SE(m)*			*CD*	*SE(d)*	*SE(m)*	
Day		0.01	0.01	0.004			0.01	0.004	0.003			0.01	0.05	0.003	
Cultivar		0.01	0.01	0.004			0.01	0.004	0.003			0.01	0.05	0.003	
Day × Cultivar		0.02	0.01	0.007			0.02	0.008	0.006			0.02	0.01	0.007	

Table 5 Effect of storage and cultivars on taste and overall acceptability of osmo air dried aonla slices

Cultivar	Taste (Days)					Overall acceptability (Days)				
	0	45	90	135	Mean	0	45	90	135	Mean
Banarasi	7.64	7.30	7.01	6.80	7.18	7.65	7.23	6.90	6.69	7.12
Chakaiya	7.63	7.21	6.83	6.74	7.10	7.89	7.60	7.23	7.00	7.43
NA 7	7.21	7.10	6.83	6.72	6.96	7.63	7.01	6.81	6.70	7.04
Desi	7.32	7.23	7.00	6.43	6.99	7.34	7.20	6.81	6.37	6.93
Mean	7.45	7.21	6.92	6.67		7.62	7.26	6.94	6.69	
Factor		*CD*	*SE(d)*	*SE(m)*			*CD*	*SE(d)*	*SE(m)*	
Day		0.012	0.006	0.004			0.01	0.004	0.003	
Cultivar		0.012	0.006	0.004			0.01	0.004	0.003	
Day × Cultivar		0.02	0.012	0.008			0.02	0.009	0.006	

been reported in osmo dehydrated papaya (Rodrigues *et al.* 2006).

It is evident from Table 4 that the colour scores of osmo air dried slices of aonla cultivars decreased during storage. The initial score for osmo air dried slices were in order of Chakaiya> Banarasi> NA 7 which decreased but remained within the acceptable limits even after 135 days of storage. The fall in colour score of the stored product was attributed to slight browning and oxidation of phenolic compounds. Similar findings have been reported in the colour of dehydrated papaya and mango slices (Sagar *et al*. 1998) during storage. A gradual decrease in texture (Table 4) was observed during storage in all the cultivars. During 135 days of storage period, there was decrease in the mean scores from 7.64 to 7.13. Similar findings have been reported in the texture of ber *chuhara* (Gupta 2007) and in osmo dehydrated apricot (Sharma *et al*. 2006), respectively. From Table 4 and 5, it was found that the sensory scores of flavour and taste of osmo air dried slices of aonla decreased with storage. The decrease in flavour scores upon storage and may be due to loss of volatile flavour components with time and interaction taking place between flavour and other constituents. At the beginning, the highest flavour score was 8.10 for osmo air dried slices developed from Chakaiya cultivar followed by 7.84 in Banarasi. The scores for overall acceptability (Table 5) of osmo air dried anola slices was highest (7.89) in Chakaiya followed by 7.65 in Banarasi. There was decrease in the mean score from 7.62 to 6.69 at the end of storage period. Similar results were reported in osmo dehydrated pineapple (Rashmi *et al*. 2005) and apricot (Sharma *et al*. 2006) during storage. Thus, on the basis of sensory evaluation (colour, flavour, taste and overall acceptability), Chakaiya and Banarasi cultivars of aonla can be commercially exploited for preparation of osmo air dried slices.

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