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Comparative Study on Development and Quality Characteristics of Aonla Sauce (*Emblica officinalis* G.) during Storage

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Aonla fruit is one of the most important fruit of tropics and subtropics. Being very astringent in taste, it less relished as a raw fruit by the consumers hence processing becomes essential. A comparative study was done to evaluate the most suitable cultivar from *Banarasi, Chakayia, NA-7* and *Desi* for development of sauce using sugar and raw sugar as per standard recipe. The processed samples were filled hot in pasteurized bottles and stored at ambient temperature. The samples were analysed for physico chemical and organoleptic parameters immediately and subsequently after 45, 90 and 135 days of storage. The total soluble solids, ascorbic acid were found to decrease while titratable acidity increased during storage. Ash content of sauce remained constant during storage in all treatments. Highest overall mean score for colour (7.32), taste (7.60), flavour (7.36) and overall acceptability (7.62) was found in sauce prepared from *Desi* followed by Banarasi cultivar with sugar as compared to other cultivars upto 135 days of storage.

Key words: Aonla sauce, total soluble solids, ascorbic acid, titratable aciditiy, overall acceptability

Aonla (Emblica officinalis G.) the Indian gooseberry is also known by several vernacular names as Amalaki, Amla, Amlet, Amolphal, Aovla, Aurna, Chukna, Dhatriphala, Nalli and Sobju in different parts of the world. It is well known for its immense medicinal values and is therefore recommended by Ayurvedic and Unani systems of medicines. In addition to this, potent antioxidant, several active tannoid principles (Emblicannin A, Emblicannin B, Puniguconin and Pedunculagin) have been identified which accounts for its health benefits (Rastogi, 1993). Amla fruits have been reported to possess expectorant, purgative, spasmolytic, antibacterial and hypoglycaemic properties. (Jayshri and Jolly,1993).

Aonla is one of the richest sources of vitamin C upto 950 mg/100g which is the highest among all the fruits next to Barbados cherry. The fruit is not consumed as fresh fruit as it is highly acidic and astringent in taste. The excellent nutritive and therapeutic values of fruit have great potentiality for processing into number of products like ready-to-serve beverage (Deka et al., 2001; jam and powder (Tripathi et al., 1988). Sauce is an important food product and mostly prepared from tomatoes. Mixture of various other fruits and starchy vegetables like pumpkin and ash gourd are sometimes employed in the preparation of fruit sauce.

In the present investigation, a comparative study of different cultivars of aonla was undertaken to value added aonla sauce using sugar and raw sugar to assess the qualitative changes and storage stability of the product.

Materials and Methods

Fresh Indian gooseberry (aonla) fruits of cultivars viz. Banarasi, Chakaiya, NA-7 and Desi were procured from Akhnoor and Regional Horticulture Research Sub Station, Raya, SKUAST-Jammu. The fruits were washed under running tap water to remove the adhering dirt, dust and analyzed for physico chemical parameters. For development of sauce, standard recipe was followed using sugar and raw sugar as per the detail given:

Treatment	Ingredients
T_1	Banarasi + Sugar
T_2	Banarasi + Raw Sugar
T_3	Chakaiya + Sugar
T_4	Chakaiya + Raw Sugar
T_5	NA-7 + Sugar
T_6	NA-7 + Raw Sugar
T_7	Desi + Sugar
T_8	Desi + Raw Sugar

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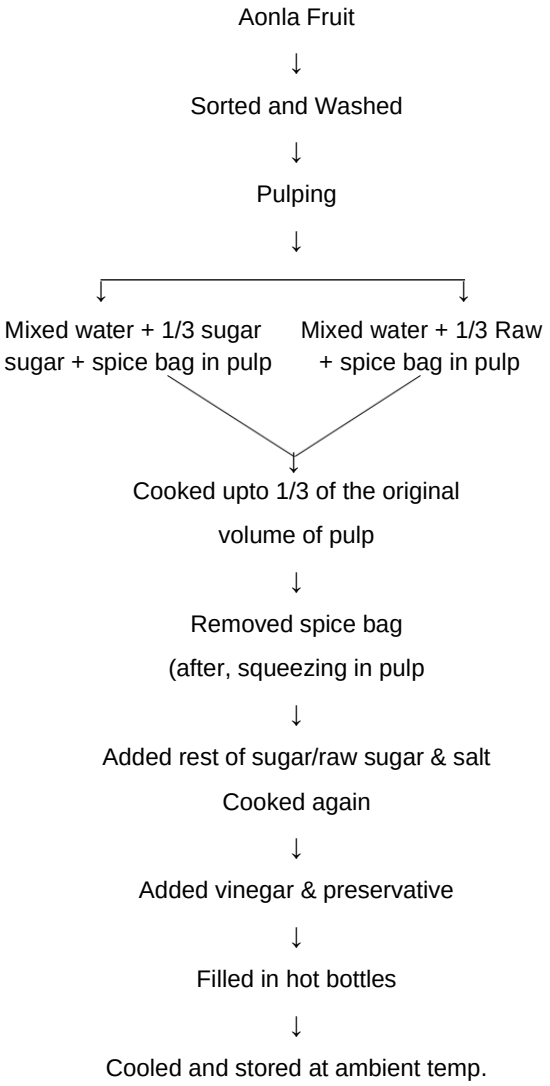

Fig. 1 . Flow sheet for Aonla Sauce

The products were stored at room temperature for 135 days. The biochemical parameters viz. titratable acidity, total sugars, reducing sugars and ascorbic acid were determined as per standard procedure (Ranganna, 2002). Developed products were also assessed organoleptically on 9 point Hedonic scale (Murray *et al.,* 2001). The data was analyzed statistically and reported at 5 per cent significance level (Panse and Sukhatame, 1961)

Results and Discussion

From Table 1, among the four cultivars analyzed, Banarasi had maximum weight 30.21g; average diameter 4.1cm and seed pulp ratio 1:1.23 per cent, followed by NA-7 and Chakaiya cultivars having fruit weight of 27.34g. 26.64g; average diameter 3.9cm, 3.8cm and seed pulp ratio 1:1.21 and 1:1.18 per cent respectively. Similar findings were reported in Banarasi cultivar while comparing two varieties of aonla viz. Banarasi and Chakaiya (Singh and Arora, 1967). Desi cultivar had minimum weight and average diameter. Banarasi had maximum moisture content 86.90 per cent followed by NA-7, 76.40; Chakaiya,

Table 1. Physico-chemical characteristics amla fruits

Parameters	Banarasi	Chakaiya	NA-7	Desi
Average Fruit weight (g)	30.21*	26.64	27.34	15.63
Average fruit height(cms)	3.40*	3.10	3.22	2.41
Average diameter(cms)	4.14*	3.88	3.90	3.12
Seed pulp ratio (%)	1.23*	1.18	1.21	1.14
Moisture (%)	86.90*	86.16	86.40	82.10
TSS°B	12.2	8.1	11.8	13.7*
Acidity (%)	2.33	2.18	2.20	2.55*
Total sugar (%)	8.03	9.62*	8.21	7.13
Reducing sugar (%)	1.07	2.01*	1.08	1.06
Pectin (%)	0.53*	0.50	0.51	0.47
Ascorbic acid (mg/100g)	647*	627	604	486

86.14 and Desi 82.10 per cent respectively. Almost similar findings have been reported for moisture content in Chakaiya and Desi cultivars. (Singh and Arora,1967).

Desi had maximum TSS 13.7$_o$B, followed by Banarasi 12.2$_o$B; NA- 7 11.8$_o$B. Maximum TSS 15.2$_o$B have also been reported by Teaotia et.al., (1968) in Desi cultivar. Maximum acidity was found in Desi cultivar followed by Banarasi, NA-7 and Chakaiya. (Singh and Arora, 1967) have also reported higher acidity of Banarasi variety when compared with Chakaiya variety of aonla. Total sugars and reducing sugar percentage were higher in Chakaiya followed by NA-7, Banarasi and Desi 9.62 and 2.01; 8.21 and 1.08; 8.03 and 1.07 and 7.13 and 1.06, respectively. Higher total sugar of 9.6 (Teaotia et. al., 1968) and 9.78 per cent (Singh et. al. 1987) was reported for Chakaiya cultivar. Pectin content was higher in Banarasi 0.53 per cent followed by NA-7, Chakaiya and then Desi 0.51; 0.50 and 0.47 per cent respectively.

Aonla is rich in Vitamin C and the maximum ascorbic acid 647mg/100g was found in Banarasi followed by Chakaiya 627mg/100g; NA-7 604mg/100g and Desi 486mg/100g. These findings were quite similar in Banarasi cultivar followed by Chakaiya (Singh and Arora, 1967). It has been found that ascorbic acid content of the fruit varies directly with the fruit weight. Banarasi variety was found to be higher in fruit weight and thus contain higher ascorbic acid (Singh et.al., 1987).

The data in Table 2 revealed that the total soluble solids in all the treatments decreased with the increase in storage period. Mean values of TSS was found to decrease from 29.75$_o$ Brix to 25.70$_o$Brix during storage for 135 days. The decrease in TSS might be due to conversion of sugars into acid. The results are in conformity with the findings of (Mehta., 1995) and (Chauhan *et al.,* 2005) in aonla blended

Table 2: Effect of storage period and treatments on Total Soluble Solids (0B) & Acidity of aonla sauce.

Treatments / storage period	Total Soluble Solids (TSS 0B)					Acidity (%)				
	Storage Intervals (Days)					Storage Intervals (Days)				
	0	45	90	135	Mean	0	45	90	135	Mean
T1 (Banarasi + S)	30.07	29.20	27.35	26.22	28.21	1.24	1.25	1.26	1.28	1.26
T2(Banarasi +RS)	29.95	28.95	27.04	25.74	27.92	1.23	1.25	1.27	1.28	1.26
T3 (Chakaiya + S)	29.53	28.83	26.92	25.42	27.68	1.25	1.26	1.28	1.29	1.27
T4(Chakaiya+ RS)	29.42	28.56	26.52	25.10	27.40	1.25	1.26	1.29	1.29	1.27
T5 (NA-7 + S)	29.82	29.11	27.32	25.41	27.92	1.24	1.26	1.28	1.29	1.27
T6 (NA-7 +RS)	29.62	28.67	27.09	25.06	27.61	1.24	1.26	1.27	1.29	1.27
T7 (Desi + S)	29.87	29.31	27.53	26.70	28.35	1.24	1.24	1.26	1.28	1.25
T8 (Desi + RS)	29.69	29.23	27.01	25.96	27.9	1.24	1.25	1.27	1.28	1.26
Mean	29.75	28.98	27.10	25.70		1.24	1.25	1.27	1.29	

Factors	C.D.	SE (d)	SE (m)	C.D.	SE (d)	SE (m)
Storage	0.0044	0.0022	0.0016	0.003	0.001	0.0010
Treatment	0.0062	0.0031	0.0022	0.004	0.002	0.0010
Storage x Treatment	0.0120	0.0062	0.0044	N.S	0.0043	0.0031

sauce. The data in Table 2 also indicated that acidity increased in all the treatment during storage. It increased from mean values of 1.24 to 1.29 per cent during 135 days of storage. The increase in titratable acidity during storage might be due to formation of organic acids by ascorbic acid degradation, because of release of free acid groups due to hydrolysis of pectin. Similar findings have been reported in tomato ketchup (Halim and Chaudhary, 1973) and in aonla blended sauce (Chauhan *et al.,* (2005).

Table 3. Effect of storage period and treatments on ash (%) and ascorbic acid (mg/100g) of aonla sauce

Treatments / storage period	Ash (%)					Ascorbic Acid (mg/100g)				
	Storage Intervals (Days)					Storage Intervals (Days)				
	0	45	90	135	Mean	0	45	90	135	Mean
T1 (Banarasi + S)	0.50	0.50	0.49	0.50	0.50	180.24	175.45	170.31	162.31	172.08
T2(Banarasi +RS)	0.50	0.50	0.49	0.50	0.50	172.43	168.34	163.15	157.32	165.31
T3 (Chakaiya + S)	0.48	0.48	0.47	0.47	0.48	176.24	171.17	167.32	160.42	168.79
T4(Chakaiya+ RS)	0.48	0.47	0.48	0.48	0.48	171.25	164.57	159.25	150.05	161.28
T5 (NA-7 + S)	0.47	0.47	0.48	0.49	0.48	165.35	160.25	155.23	148.21	157.26
T6 (NA-7 +RS)	0.48	0.49	0.48	0.47	0.48	160.23	157.33	150.13	142.21	152.47
T7 (Desi + S)	0.46	0.47	0.46	0.46	0.46	150.65	140.65	142.22	137.24	142.69
T8(Desi + RS)	0.46	0.47	0.47	0.46	0.47	144.30	142.22	137.31	133.55	139.34
Mean	0.48	0.48	0.48	0.48		165.08	160.00	155.61	148.91	

Factors	C.D.	SE (d)	SE (m)	C.D.	SE (d)	SE (m)
Storage	N.S	0.001	0.001	1.177	0.589	0.416
Treatment	0.004	0.002	0.001	1.665	0.833	0.589
Storage x Treatment	0.01	0.004	0.003	3.33	1.667	1.178

Table 3 showed that initially maximum ascorbic acid content of 180.24mg/100gm was recorded in T_1 (Banarasi + Sugar) treatment and lowest 144.30mg/100g was obserbed in T_7 (desi + raw sugar) treatment. As the storage period advanced, there was decrease in ascorbic acid content of aonla sauce. The mean ascorbic acid content during 135 days of storage declined significantly from initial mean value of 165.08 mg/100gm to 148.91 mg/100gm. Ascorbic acid may be destroyed by oxidation especially at higher temperature, its stability is greatly influenced by temperature, oxygen and metal ion content. The losses of ascorbic acid is probably attributable to oxidation of ascorbic acid to dehydro ascorbic acid followed by hydrolysis of the latter to 2,3 diketo gluconic acid which is turn undergoes polymerization to other nutritional inactive products (Dewanto *et al.,* 2002). Similar decline in ascorbic acid content has also been reported in tomato ketchup during storage (Pruthi *et al.,* 1980), aonla blended sauce (Chauhan *et al.,* 2005) and in sweet papaya chutney (Gupta 2000). Table also showed that the ash content of the sauce remained constant during storage.

Table 4. Effect of storage and treatments on organoleptic rating of aonla sauce

Treatments/ storage period	Colour					Taste				
	0 days	45 days	90 days	135 days	Mean	0 days	45 days	90 days	135 days	Mean
T1 (Banarasi + S)	7.88	7.13	7.01	6.83	7.21	7.79	7.59	7.40	7.10	7.47
T2(Banarasi +RS)	7.12	7.11	6.94	6.81	6.99	7.21	7.02	6.81	6.52	6.89
T3 (Chakaiya + S)	7.51	7.15	7.01	6.81	7.12	7.63	7.51	7.31	7.14	7.39
T4(Chakaiya+ RS)	7.01	6.95	6.82	6.45	6.81	7.11	6.81	6.70	6.41	6.76
T5 (NA-7 + S)	7.31	7.00	6.82	6.53	6.91	7.51	7.10	7.96	6.90	7.36
T6 (NA-7 +RS)	7.10	6.81	6.51	6.50	6.73	7.21	6.90	6.71	6.30	6.78
T7 (Desi + S)	7.71	7.25	7.21	7.10	7.32	7.90	7.72	7.51	7.30	7.60
T8 (Desi + RS)	7.16	7.10	7.01	6.89	7.04	7.31	7.00	6.90	6.70	6.98
Mean	7.35	7.06	6.91	6.74		7.46	7.21	7.16	6.79	

Factors	C.D.	SE (d)	SE (m)	C.D.	SE (d)	SE (m)
Storage	0.004	0.002	0.001	0.0177	0.088	0.062
Treatment	0.006	0.003	0.002	0.251	0.125	0.088
Storage x Treatment	0.01	0.006	0.004	N.S	0.251	0.177

It is evident from Table 4, sauce prepared from treatment T_1 (Banarasi + sugar) and T_7 (Desi + sugar) received maximum score for colour initially i.e. 7.88 and 7.71. Sauce prepared from T_7 (desi + sugar) was judged best for colour parameter by scoring 7.10 after 135 days of storage. Mean score for colour of aonla sauce declined from 7.35 to 6.74 during 135 days of storage. The decrease in colour might be attributed to the increase in non enzymatic browning and oxidation of phenolic compounds. Similar findings have been reported in Strawberry sauce (Shazia, 2010) and in papaya pumpkin blended sauce (Riyaz, 2009). Sauce prepared from (Desi + sugar) and (Banarasi + sugar) attained maximum score for taste 7.30 and 7.10, respectively. A gradual decrease in taste was observed during storage. It was found that mean score for taste 7.46 declined to 6.79 after 135 days of storage. Similar findings were observed (Kumar and Manimegalai, 2001) in strawberry sauce during three months storage. Mean score for flavour also decreased during storage(Table 5). A decrease on overall acceptability score was also observed in all the treatments with advancement of storage period. Maximum overall acceptability score 7.30 was recorded in T_7 (Desi + sugar) followed by 7.15 in T_1 (Banarasi + sugar) treatment . Mean score for overall acceptability decreased from 7.64 to 6.81 after 135 days of storage. Similar findings were observed by (Fernandes and Mc Lellan, 1992) in apple sauce.

Table 5. Effect of storage and treatments on flavour and acceptability of aonla sauce

Treatments/ storage period	Flavour					Overall acceptability				
	0 days	45 days	90 days	135 days	Mean	0 days	45 days	90 days	135 days	Mean
T1 (Banarasi + S)	7.50	7.31	7.11	6.91	7.20	7.92	7.60	7.43	7.15	7.52
T2 (Banarasi +RS)	7.01	6.71	6.57	6.33	6.65	7.14	7.01	6.95	6.46	6. 89
T3 (Chakaiya + S)	7.48	7.32	7.10	6.90	7.20	7.90	7.56	7.31	7.09	7.46
T4 (Chakaiya+ RS)	7.20	7.00	6.51	6.31	6.76	7.19	7.04	6.98	6.56	6.94
T5 (NA-7 + S)	7.31	7.20	7.02	6.91	7.11	7.64	7.24	7.03	6.81	7.18
T6 (NA-7 +RS)	7.01	6.80	6.62	6.12	6.64	7.11	6.84	6.51	6.21	6.67
T7 (Desi + S)	7.81	7.51	7.12	7.00	7.36	8.00	7.69	7.51	7.30	7.62
T8 (Desi + RS)	7.32	6.91	6.42	6. 36	6.75	7.94	7.60	7.31	6.92	7.44
Mean	7.34	7.12	6.82	6.86		7.61	7.34	7.15	6.82	

Factors	C.D.	SE (d)	SE (m)	C.D.	SE (d)	SE (m)
Storage	0.176	0.088	0.062	0.006	0.003	0.002
Treatment	0.249	0.124	0.088	0.009	0.004	0.003
Storage x Treatment	0.498	0.249	0.176	0.019	0.009	0.006

Higher sensory score for colour, taste, flavor and overall acceptability was observed in sauce prepared from Desi followed by Banarasi cultivar with sugar and thus found to be best as compared to sauce prepared from other cultivars upto 135 days of storage.

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