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EFFECT OF POST HARVEST TREATMENTS ON QUALITY AND SHELF LIFE OF AONLA CULTIVARS

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ABSTRACT : Freshly harvested mature fruits of aonla (Emblica officinalis Gaertn) cultivars namely NA-7, NA-10, Chakaiya and a wild aonla were dipped in GA_3 100 mg L^{-1}, 200 mg L^{-1}, 300 mg L^{-1}, MH 100 mg L^{-1}, 200 mg L^{-1}, 300 mg L^{-1} and $CaCl_2$ 10 g L^{-1} 20 g L^{-1}, 30 g L^{-1} solutions. Fruits were surface dried, packed in nylon net bags and kept in room temperature (15.5±4°C) and RH 62.7%. Among the different post harvest treatments, it was found that GA_3 200 mg L^{-1} was best in reducing the physiological loss. No pathological loss was observed in all the treatments upto 14 days of storage. The maximum TSS content was recorded with GA_3 treatment. GA_3 300 mg L^{-1} treatment gave better retention of ascorbic acid and malic acid during the storage of aonla.

Keywords : *Emblica officinalis, bioregulators, ascorbic acid, storage life.*

Aonla (*Emblica officinalis* Gaertn), popularly known as Indian gooseberry, is a small sized, minor subtropical fruit belonging to the family Euphorbiaceae. It is thought to be native of India, Ceylon, Malaysia and China. It thrives well throughout tropical and subtropical India and is wild or cultivated in the region extending from the base of Himalaya to Ceylon and Malaysia to south China. It can be grown successfully in dry and neglected region owing to its hardy nature, suitability to various kinds of wasteland. The major difference between these wild trees and the large-fruited types cultivated in the plains is of winter-hardiness. Whereas the improved types are highly susceptible to frost injury, the trees of wild aonla are not damaged at all. It is a rich source of vitamin C and its content of ascorbic acid is next to only that of Barbados cherry (*Malpighia glabra* L.). The important varieties grown in India are Banarasi, Chakaiya, Pink tinged, Krishna, Kanchan, Francis, Pratapgarh, Hathijhool, NA-7 and NA-10.

The medicinal properties of aonla have been mentioned in old *Ayurvedic* texts, such as *Charaksamhita* and *Sushrutsamhita* (Kirtikar and Basu, 5). Aonla preserve has the beneficial effect of purifying blood. This also helps in reducing the cholesterol levels in blood and in improving eye sight. It lowers the risk of cancer. Aonla increases the red blood cells and haemoglobin. Leaves of aonla are useful in curring conjunctivitis, inflammation, diarrhoea, dysentery. The aonla preserve is one of the specialties of the Indian fruit-preservation industry. In order to fulfill this demand the fruit is to be transported to places other than the centre of production as its storage in ambient atmosphere is very limited. Growth regulator and fumigates applied as post harvest treatment have been reported to increase the shelf life of the fruits (Khader *et al.,* 4; Yadav and Singh, 13). Keeping the above facts in mind, present investigation was conducted to evaluate the effect of growth regulators and chemicals on biochemical changes in aonla fruits during storage.

MATERIALS AND METHODS

The present investigation was carried out at the Department of Horticulture, HNB Garhwal University, Srinagar (Garhwal) during the year 2010-11. The freshly mature fruits of aonla cultivars namely NA-7, NA-10, Chakaiya and wild aonla were harvested from 5 years old plants standing at Horticultural Research Centre of University in morning hours and brought to laboratory of Horticulture Department and were dipped in GA_3 (100 mg L^{-1}, 200 mg L^{-1}, 300 mg L^{-1}), MH (100 mg L^{-1} 200 mg L^{-1}, 300 mgL^{-1}) and $CaCl_2$ (10 g L^{-1}, 20 g L^{-1}, 30 g L^{-1}) solutions. The fruits after treatment were surface dried and then packed in nylon net bags. Each bag was packed with 35 fruits each and all the treatments were replicated 3 times. These bags were kept in room temperature (15.5±4°C) and RH of 62.7%. The treated fruits were kept for recording the observation with the intervals of 7 days up to 35 days. Pathological losses were recorded by visual observation; the physiological loss in weight (PLW) of the fruit was determined on the basis of initial weight of

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the fruit and loss in weight that occurred and were expressed in per cent, total soluble solids were recorded by hand refractometer and the values were corrected for 20°C, ascorbic acid and acidity content were determined by titration method according to Ranganna (12). Finally statistical analysis was done for all the data obtained.

RESULTS AND DISCUSSION

Physiological fruit weight loss was increased with the days of storage in all treatment. The minimum fruit weight loss (17.67%) was recorded in GA_3 200 mg L^{-1} treatment in NA-7 while maximum fruit weight loss (42.19%) was observed in control (Table 1). In cultivar NA-10, the minimum fruit weight loss (27.729%) was noticed in $CaCl_2$ 10 g L^{-1} treatment while maximum fruit weight loss (56.72%) was in control set. In cultivar Chakaiya and wild aonla, the minimum fruit weight loss (19.18% and 36.68%, respectively) was noticed with GA_3 100 mg L^{-1} treatment and maximum loss was noticed in control sets. Similar findings have also been reported by Gangwar *et al.* (2) and Dhillon and Kaur (1).

There was no pathological loss up to 14th day of storage in all the treatments of the four cultivars. Pathological loss was lowest in wild aonla (6.65%) followed by NA-7 (20.0%), NA-10 (25.21%) and Chakaiya (28.57%) in $CaCl_2$ 30 g L^{-1} treatment. The maximum pathological loss of fruits was noticed in control under all cultivars studied (Table 2). Yadav and Singh (13) have also reported lowest losses in weight (11.09%) and decay (14.43%) and prolonged shelf life in aonla fruits by two pre harvest sprays of 1% calcium nitrate + 0.1% Topsin-M.

Total soluble solids (TSS) increased with the increase in the duration of storage irrespective of treatments. Among the different treatments, the maximum TSS content (39.82%) was increased in NA-7 fruits treated with GA_3 100 mg L^{-1} and 44.48% increased in NA-10 fruits under same treatment after 35 days of storage. In wild aonla, TSS was increased in GA_3 200 mg L^{-1} and 300 mg L^{-1} treatments. In Chakaiya cultivar, the highest TSS was recorded in $CaCl_2$ treated fruits (Table 3). Increase in TSS due post harvest application of chemicals is line of Nishad *et al.* (10) and Kumar *et al.* (6). Decrease in malic acid content was recorded minimum (29.14%) in cv. Chakaiya fruits treated with GA3 300 mgL-1 while maximum decrease (96.43%) was observed in fruits of cultivar NA-7 treated with $CaCl_2$ 30 gL^{-1} (Table 4). Ascorbic acid content decreased with the duration of storage in all the treatments. The minimum (11.46%) ascorbic acid decrease was recorded in fruits of Chakaiya cultivar treated with GA_3 300 $mg.L^{-1}$ and

Table 1: Effect of post harvest treatments on physiological loss of fruit weight in aonla (*Emblica officinalis* Gaertn) cultivars.

Treatment	Cultivars											
	NA-7			NA-10			Chakaiya			Wild Aonla		
	Fresh fruit weight (g)	Weight (g) after 35days	% weight loss	Fresh fruit weight (g)	Weight (g) after 35days	% weight loss	Fresh fruit weight (g)	Weight (g) after 35days	% weight loss	Fresh fruit weight (g)	Weight (g) after 35days	% weight loss
GA_3 100 $mg.L^{-1}$	42.30	32.22	23.83	23.26	15.75	32.29	39.84	32.20	19.18	3.49	2.14	36.68
GA_3 200 $mg.L^{-1}$	41.32	34.02	17.67	21.28	12.30	42.19	38.86	27.32	29.69	3.60	1.93	46.39
GA_3 300 $mg.L^{-1}$	40.33	30.40	24.62	23.37	14.63	37.39	40.80	31.20	23.53	3.29	1.77	46.20
MH 100 $mg.L^{-1}$	44.34	36.44	17.82	21.39	11.43	46.59	41.83	30.05	28.16	3.19	1.65	48.28
MH 200 $mg.L^{-1}$	41.38	31.90	22.03	23.69	13.21	42.97	40.82	30.22	25.96	3.62	1.96	45.86
MH 300 $mg.L^{-1}$	42.39	29.33	30.81	22.29	10.40	53.34	38.90	29.86	23.24	3.61	2.01	44.32
$CaCl_2$ 10 $g.L^{-1}$	44.39	33.84	23.77	21.58	15.60	27.72	37.78	28.73	23.82	3.79	2.13	43.80
$CaCl_2$ 20 $g.L^{-1}$	43.31	29.19	32.60	20.20	10.84	46.34	38.67	27.40	29.14	3.72	2.10	43.55
$CaCl_2$ 30 $g.L^{-1}$	1.50	25.49	38.57	24.22	15.50	36.00	39.76	28.10	29.32	3.49	1.77	49.28
Control	40.36	23.33	42.19	23.20	10.04	56.72	37.68	25.53	32.25	3.30	1.66	49.70
CD (P=0.05)	0.001	0.112	0.004	0.075	0.002	0.005	0.001	0.00	0.002	0.006	0.00	0.000

Table 2 : Effect of post harvest treatments on pathological fruit loss in aonla (*Emblica officinalis* Gaertn) cultivars.

Treatment	Cultivars											
	NA-7			NA-10			Chakaiya			Wild Aonla		
	No. of Fresh fruit taken	Infected fruits after 35 days	% fruit loss	No. of Fresh fruit taken	Infected fruits after 35 days	% fruit loss	No. of Fresh fruit taken	Infected fruits after 35 days	% fruit loss	No.of Fresh fruit taken	Infected fruits after 35 days	% fruit loss
GA_3 100 mg L^{-1}	35	12.67	36.20	35	13.00	37.10	35	12.00	34.20	35	8.00	22.85
GA_3 200 mg L^{-1}	35	13.00	37.10	35	16.00	46.65	35	14.00	40.00	35	8.00	22.85
GA_3 300 mg L^{-1}	35	14.00	40.00	35	10.00	28.57	35	13.00	37.10	35	11.00	31.42
MH 100 mg L^{-1}	35	14.00	40.00	35	15.00	43.80	35	12.00	34.20	35	11.00	31.42
MH 200 mg L^{-1}	35	16.33	46.65	35	10.00	28.57	35	12.00	34.20	35	7.00	20.00
MH 300 mg L^{-1}	35	12.00	34.20	35	17.33	49.51	35	10.00	28.57	35	5.00	14.28
$CaCl_2$ 10 g L^{-1}	35	12.00	34.20	35	13.00	37.10	35	10.00	28.57	35	7.00	20.00
$CaCl_2$ 20 g L^{-1}	35	11.00	31.42	35	10.33	29.51	35	11.00	31.42	35	2.66	7.60
$CaCl_2$ 30 g L^{-1}	35	7.00	20.00	35	9.00	25.71	35	10.00	28.57	35	2.33	6.65
Control	35	15.33	43.80	35	17.33	49.51	35	14.00	40.00	35	11.00	31.42
CD (P=0.05)	0.00	1.76	0.000	0.00	1.83	0.004	0.00	1.43	0.002	0.00	1.04	0.002

Table 3: Effect of post harvest treatments on TSS content of fruits in aonla (*Emblica officinalis* Gaertn) cultivars.

Treatment	Cultivars											
	NA-7			NA-10			Chakaiya			Wild Aonla		
	TSS of fresh fruits	TSS after 35days	% TSS increase	TSS of fresh fruits	TSS after 35days	% TSS increase	TSS of fresh fruits	TSS after 35days	% TSS increase	TSS of fresh fruits	TSS after 35days	% TSS increase
GA_3 100 mg.L^{-1}	7.03	9.83	39.82	9.8	14.16	44.48	6.83	8.46	23.86	11.43	18.73	63.86
GA_3 200 mg.L^{-1}	7.03	9.8	39.40	9.8	11.36	15.91	6.83	8.60	25.91	11.43	18.90	65.35
GA_3 300 mg.L^{-1}	7.03	9.53	35.56	9.8	11.56	17.95	6.83	9.46	38.50	11.43	18.90	65.35
MH 100 mg.L^{-1}	7.03	8.90	26.60	9.8	12.73	29.89	6.83	8.86	29.72	11.43	18.13	58.61
MH 200 mg.L^{-1}	7.03	9.43	34.13	9.8	14.13	44.18	6.83	9.50	39.09	11.43	18.63	62.99
MH 300 mg.L^{-1}	7.03	9.43	34.13	9.8	10.83	10.51	6.83	7.80	14.20	11.43	18.53	62.11
$CaCl_2$ 10 g.L^{-1}	7.03	9.46	34.56	9.8	11.00	12.24	6.83	10.76	57.54	11.43	18.90	65.35
$CaCl_2$ 20 g.L^{-1}	7.03	9.63	36.98	9.8	11.46	16.93	6.83	10.13	48.31	11.43	18.33	60.36
$CaCl_2$ 30 g.L^{-1}	7.03	9.53	35.60	9.8	12.20	24.48	6.83	8.46	23.86	11.43	18.63	63.99
Control	7.03	8.56	21.76	9.8	12.50	27.55	6.83	8.83	29.28	11.43	16.90	47.85
C D (P=0.05)	0.00	0.200	0.004	0.00	0.100	0.006	0.00	0.130	0.010	0.00	0.160	0.003

maximum (92.90%) decrease was noted in wild aonla treated as control on the 35 days of storage (Table 5).

In this study of post harvest treatments in fruits of aonla cultivars, significant variation in physiological loss in weight of fruits, pathological loss of fruits, decrease in acid and vitamin C content of fruits during storage with chemical treatments were noticed. The variation in these characters between cultivars might be due to differences in composition and morphology of fruits of cultivars. The minimum loss may be due to which it controlled the disintegration of mitochondria,

Table 4: Effect of post harvest treatments on malic acid content of fruits in aonla (*Emblica officinalis* Gaertn) cultivars.

Treatment	Cultivars											
	NA-7			NA-10			Chakaiya			Wild Aonla		
	Fresh fruits	After 35 days	% decrease	Fresh fruits	After 35 days	% decrease	Fresh fruits	After 35 days	% decrease	Fresh fruits	After 35 days	% decrease
GA_3 100 mg L^{-1}	0.140	0.046	67.14	0.156	0.060	61.54	0.171	0.067	60.82	0.344	0.097	71.80
GA_3 200 mg L^{-1}	0.140	0.053	62.14	0.156	0.044	71.79	0.171	0.118	30.99	0.344	0.102	70.35
GA_3 300 mg L^{-1}	0.140	0.053	62.14	0.156	0.067	57.05	0.171	0.154	29.14	0.344	0.102	70.35
MH 100 mg L^{-1}	0.140	0.048	65.71	0.156	0.044	71.79	0.171	0.067	60.82	0.344	0.009	74.13
MH 200 mg L^{-1}	0.140	0.064	54.29	0.156	0.011	92.95	0.171	0.060	64.91	0.344	0.080	76.74
MH 300 mg L^{-1}	0.140	0.005	96.43	0.156	0.019	87.82	0.171	0.078	54.38	0.344	0.089	74.13
$CaCl_2$ 10 g L^{-1}	0.140	0.016	88.57	0.156	0.082	47.44	0.171	0.053	69.00	0.344	0.089	74.13
$CaCl_2$ 20 g L^{-1}	0.140	0.095	32.14	0.156	0.127	18.60	0.171	0.051	70.17	0.344	0.080	76.74
$CaCl_2$ 30 g L^{-1}	0.140	0.084	40.00	0.156	0.117	25.00	0.171	0.058	66.08	0.344	0.076	77.91
Control	0.140	0.067	52.14	0.156	0.055	64.74	0.171	0.079	53.80	0.344	0.062	81.98
CD (P=0.05)	0.00	0.060	0.097	0.00	0.016	0.013	0.00	0.012	0.000	0.00	0.019	0.000

endoplasmic reticulum and cytoplasmic membranes and respiration due to stomata closure (Yadav and Singh,13). Khader *et al.* (4) also reported that post-harvest treatment with gibberellic acid at the rate of 100 or 200 mg L^{-1} significantly delayed ripening of mango fruits cultivar 'Mallika'. Similarly, Hassan *et al.* (3) observed that treatment of $CaCl_2$ (4%) + HDPE significantly reduced physiological weight loss, change in diameter and change in specific gravity of aonla fruits during storage as compared to other treatments. Post harvest treatments of fruits with chemicals prolonged shelf life as well as quality of guava fruits (Nishad *et al.,* 10) and the lowest spoilage incidence in fruits and highest total soluble solids content in fruits (Nigam and Ganesh, 9). Reduced decay loss might be due to its antiseptic nature or reduction of moisture in fruits. The

Table 5 : Effect of post harvest treatments on ascorbic acid content of fruits in aonla (*Emblica officinalis* Gaertn) cultivars

Treatment	Cultivars											
	NA-7			NA-10			Chakaiya			Wild aonla		
	Fresh fruit	After 35days	% decrease	Fresh fruit	After 35days	% decrease	Fresh fruit	After 35days	% decrease	Fresh fruit	After 35days	% decrease
GA_3 100 mg L^{-1}	226.40	82.10	63.73	331.20	111.47	66.34	187.20	114.03	39.08	537.60	76.27	85.81
GA_3 200 mg L^{-1}	226.40	90.57	60.00	331.20	115.13	65.23	187.20	147.40	21.26	537.60	81.40	84.85
GA_3 300 mg L^{-1}	226.40	136.77	39.59	331.20	154.37	53.39	187.20	165.73	11.46	537.60	98.27	81.72
MH 100 mg L^{-1}	226.40	86.17	61.94	331.20	86.90	73.76	187.20	93.50	50.05	537.60	77.73	85.54
MH 200 mg L^{-1}	226.40	96.07	57.57	331.20	105.97	68.00	187.20	131.63	29.68	537.60	77.73	85.54
MH 300 mg L^{-1}	226.40	103.77	54.16	331.20	106.33	67.89	187.20	138.60	25.96	537.60	73.33	86.35
$CaCl_2$ 10 g L^{-1}	226.40	95.33	57.89	331.20	83.60	74.75	187.20	118.43	36.73	537.60	79.93	85.13
$CaCl_2$ 20 g L^{-1}	226.40	101.93	54.97	331.20	100.47	69.66	187.20	97.17	48.09	537.60	76.27	85.81
$CaCl_2$ 30 g L^{-1}	226.40	105.97	53.19	331.20	110.73	66.56	187.20	91.67	51.03	537.60	55.73	89.63
Control	226.40	80.67	64.37	331.20	56.83	82.84	187.20	68.77	63.26	537.60	38.13	92.91
CD (P=0.05)	0.00	4.960	0.000	0.00	4.020	0.002	0.00	6.210	0.098	0.00	9.600	0.313

rapid decrease in acidity under prolonged storage might be due to rapid utilization of organic acid during respiration as reported by Nath *et al.* (8). The maximum retention of vitamin C may be due to the lowering of respiration rate and slow oxidation process. They also reported that ascorbic acid was higher in GA_3 treatment as compared to other treatments., GA_3 treatment retarded the total loss in weight, chlorophyll and ascorbic acid content, and reduced amylase and peroxidase activity during ripening Khader *et al.*, 4) Postharvest calcium treatments tend to reduce the incidence of disorders, lower respiration rates and aid in firmness retention but can be injurious to the skin of some cultivars Meheriuk and Sholberg, 7). Pilai *et al.* (11) concluded that post harvest chemical treatment with GA_3, $CaCl_2$ and SA has the potential to control decaying incidence, prolong the storage life and preserve valuable attributes of post harvest tomato, presumably because of its effect on inhibition of ripening and senescence processes.

The variation in cultivars for post harvest quality changes with different chemicals is because of the variation in fruit morphology of cultivars. .

CONCLUSION

From the results of this study it can be concluded that shelf life of aonla goes on decreasing with the prolong days of storage. GA_3 (300 mg L^{-1}) treatment was found to be effective in retaining the quality of aonla fruits while $CaCl_2$ at 30 g L^{-1} was found to be effective in minimising the pathological loss of fruits in aonlal cultivars studied.

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