Biological Forum – An International Journal **14(4): 969-972(2022)**

ISSN No. (Print): 0975-1130
ISSN No. (Online): 2249-3239

Effect of different Post-Harvest Treatments on Biochemical Attributes of Aonla cv. Chakaiya

Singh Manmohan[1], Singh Surender[2*], Yadav Bijender Singh[2] and Mayank[2]
[1]Department of Horticulture,
Chaudhary Charan Singh Haryana Agricultural University, Hisar (Haryana), India.
[2]Departmentof Fruit Science,
Maharana Pratap Horticultural University, Karnal (Haryana), India.

(Corresponding author: Singh Surender)*
(Received 17 September 2022, Accepted 27 October, 2022)
(Published by Research Trend, Website: www.researchtrend.net)

ABSTRACT: As the aonla fruit is perishable in nature. Therefore, it needs to investigate the post-harvest studies. The study was carried out at Post-harvest Laboratory, Department of Horticulture, College of Agriculture, CCSHAU, Hisar during the year 2020-21, on various biochemical changes in aonla fruits to determine appropriate post-harvest treatment for better quality and desirable shelf life under ambient condition. Effect of post-harvest treatments with GA_3 (400, 500 and 600 ppm), $Ca(NO_3)_2$ (1.0, 2.0 and 3.0%), $KMnO_4$ (1000, 2000 and 3000 mg) and bael leaf extract (2.0, 3.0 and 4.0%) on the storage behavior of aonla fruits harvested at physiological mature stage were studied. Fruits were stored at room temperature and evaluated on alternate days for various biochemical attributes. Results showed that the fruits treated with $GA_3$600 ppm had the maximum TSS (8.04°Brix) and organoleptic rating (7.3), while the minimum (7.55°Brix and 6.5, respectively) was in control. The highest titratable acidity (1.83%) and ascorbic acid (472.5 mg/100 g) was retained in GA_3 600 ppm treated fruits and minimum (1.68% and 456.2 mg/100 g, respectively) in control. The minimum phenol content (1.72%) was observed in fruits treated with GA_3 600 ppm and maximum (1.81%) in untreated fruits. The maximum TSS to acid ratio (4.45) was observed in GA_3 600 ppm treated fruits and minimum (4.38) in bael leaf extract 2% and 3% treated fruits. In present study, gibberellic acid 600 ppm was proved to be best treatment for maintaining the biochemical attributes of fruits.

Keywords: TSS, ascorbic acid, aonla, post-harvest treatments, ambient condition, biochemical changes.

INTRODUCTION

Indian gooseberry or Aonla (*Emblica officinalis* Gaertn. Syn. *Phyllanthus emblica*) belongs to family Euphorbiaceae. It is known by different names in different regions such as ‘Amalakki’, ‘Nelli’, ‘Amla’, etc. (Shekhawat *et al*., 2014). It is a second richest source of vitamin C and ascorbic acid after Barbados cherry (*Malpighia glabra* L.). It has long been used for therapeutic purposes and is usually suggested for its synergistic effects in both ayurveda and unani medical systems. Expectorant, purgative, spasmolytic, antibacterial, hypoglycemic, and hypolipidemic properties have been documented for Aonla (Mishra *et al*., 2010; Arya *et al*., 2021). The shelf life of aonla fruits is up to 5-6 days at ambient conditions after harvest due to its highly perishable nature (Pathak *et al*., 2009). As a result, it requires quick marketing and use. To get a reasonable return and avoid marketing oversupply, it is necessary to store the fruit for long time. The extension of storage life may be possible by limiting the rate of transpiration, respiration and by checking microbial infection (Dhumal and Karale 2008). Post-harvest losses can be reduced upto 30% with proper storage and processing methods. Goyal *et al*. (2008) and make the fruit available for longer period (Singh *et al*., 2009). Thus, to overcome the post-harvest losses, the present investigation was undertaken to study the effect of post-harvest treatments on biochemical parameters of aonla cv. Chakaiya.

MATERIALS AND METHODS

The present experiment was carried out at Post-harvest Laboratory, Department of Horticulture, College of Agriculture, CCSHAU, Hisar during 2020 to 2021. The aonla fruits of cultivar Chakaiya free from bruises and diseases and having uniform size, shape and colour were harvested at physiological mature stage. The fruits were subjected to dip treatment in aqueous solution of different concentration of GA_3 (400, 500 and 600 ppm),

$Ca(NO_3)_2$ (1.0, 2.0 and 3.0%) and bael leaf extract (2.0, 3.0 and 4.0%) each for 10 minutes. The fruits were air dried and packed in perforated polythene bags and stored in room temperature. In case of potassium permanganate treatment, the potassium permanganate (1000, 2000 and 3000 mg) was kept in small piece of cloth and placed along with fruits. Then fruits were packed in perforated PE bags and stored at room temperature. A control lot of fruit (kept in perforated polythene bags without any treatment) was also stored in same condition. The entire experiment was laid out in completely randomized design (factorial) with three replications. Under each treatment two kg fruits maintained for analyzing the observations. The total soluble solid (TSS) of fruits was estimated with the help of an ERMA hand refractometer of the range of 0-32%. The titratable acidity and ascorbic acid were determined by the method described by AOAC (1990). The total soluble solids to acid ratio were determined by dividing total soluble solids and titratable acidity. Organoleptic rating was determined on the basis of colour and appearance, taste, flavor and overall acceptability of the fruits by panel of five judges as per 'Hedonic Scale' (1-9 points) (Ranganna, 1977). The total phenols in the fruit tissue were estimated by procedure formulated by Amorium *et al.* (1977) using Folin-ciocalteau's reagent. The observations were recorded at two days interval. The statistical analysis was done by the method of analysis of variance given by (Gomez and Gomez 1981) with the help of OPSTAT statistical software.

Table 1: Effect of post-harvest treatments on TSS (°Brix) and titratable acidity (%) of aonla fruits during storage.

Treatments	**TSS (°Brix)**							**Titratable acidity (%)**						
	Storage period (days)													
	2	**4**	**6**	**8**	**10**	**12**	**Mean**	**2**	**4**	**6**	**8**	**10**	**12**	**Mean**
GA_3 400 ppm	7.05	7.47	7.84	8.12	8.34	8.54	7.89	2.03	1.91	1.81	1.74	1.68	1.62	1.8
GA_3 500 ppm	7.07	7.5	7.87	8.16	8.38	8.59	7.93	2.03	1.93	1.83	1.76	1.7	1.65	1.82
GA_3 600 ppm	7.11	7.58	7.98	8.29	8.54	8.76	8.04	2.04	1.93	1.84	1.77	1.71	1.66	1.83
$Ca(NO_3)_2$ 1%	7.06	7.49	7.86	8.15	8.38	8.58	7.92	2.04	1.92	1.81	1.76	1.7	1.62	1.81
$Ca(NO_3)_2$ 2%	7.03	7.44	7.78	8.05	8.27	8.46	7.84	2.02	1.9	1.8	1.72	1.66	1.6	1.78
$Ca(NO_3)_2$ 3%	7.01	7.39	7.73	7.98	8.19	8.37	7.78	2	1.89	1.79	1.71	1.65	1.59	1.77
$KMnO_4$ 1000 mg	6.97	7.33	7.64	7.87	8.06	8.23	7.68	2.01	1.89	1.79	1.7	1.63	1.57	1.77
$KMnO_4$ 2000 mg	6.99	7.35	7.67	7.91	8.11	8.28	7.72	2.02	1.88	1.78	1.71	1.65	1.57	1.77
$KMnO_4$ 3000 mg	7.02	7.41	7.75	8.02	8.22	8.41	7.81	2.02	1.9	1.8	1.73	1.66	1.59	1.79
Bael leaf extract 2%	6.93	7.25	7.52	7.74	7.91	8.06	7.57	2.01	1.88	1.77	1.68	1.61	1.55	1.75
Bael leaf extract 3%	6.94	7.27	7.56	7.78	7.95	8.11	7.6	2.01	1.88	1.77	1.69	1.62	1.56	1.76
Bael leaf extract 4%	6.96	7.31	7.61	7.84	8.02	8.19	7.65	2.01	1.88	1.77	1.69	1.62	1.56	1.76
Control	6.92	7.24	7.51	7.72	7.88	8.03	7.55	2.01	1.87	1.76	1.67	1.6	1.54	1.74
Mean	7.01	7.39	7.72	7.97	8.17	8.36		2.02	1.89	1.78	1.7	1.64	1.57	
CD at 5% level of significance	Treatment (T) = 0.14 Storage period (S) = 0.09 T×S = NS							Treatment (T) = 0.03 Storage period (S) = 0.02 T×S = NS						
	Initial TSS = 6.53							Initial titratable acidity = 2.17						

RESULTS AND DISCUSSION

A. Total soluble solids (°Brix)

Data presented in Table 1 showed that TSS of fruits was significantly influenced by treatments with respect to the period of storage. Among the treatments, the highest (8.04°Brix) TSS was recorded in gibberellic acid 600 ppm treated fruits, which was statistically at par with gibberellic acid 500 ppm (7.93°Brix) and calcium nitrate 1.0% (7.92°Brix), while the lowest (7.55°Brix) TSS was recorded in control. Similar results were obtained by Thokchom and Mandal (2018) in aonla fruits. It was observed that total soluble solids increased during storage among all the treatments. The increase in total soluble solids may be due to conversion starchinto sugars and hydrolysis of polysaccharides of cell wall during storage (Thokchom and Mandal 2018).

B. Titratable acidity (%)

It is evident from the Table 1 that different treatments influenced the titratable acidity significantly. The maximum (1.83%) titratable acidity was observed in gibberellic acid 600 ppm treated fruits, which was statistically at par with gibberellic acid 500 ppm (1.82%), calcium nitrate 1.0% (1.81%), gibberellic acid 400 ppm (1.80%) and the minimum (1.68%) was recorded in untreated fruits. These results are in close conformity with the earlier findings of Thokchom and Mandal (2018) in aonla, Rajkumar and Manivanan (2007) in papaya and (Zomo *et al.*, 2014) in banana. The titratable acidity reduced with the prolongation of storage period might be due to various acids might have been utilized in various physiological processes prevailing in the fruits and bio-conversion of organic acids to sugars (Bhullar *et al*., 1981).

C. Ascorbic acid (mg/100 g pulp)

The data pertaining to ascorbic acids presented in Table 2 showed that the highest (472.5 mg/100 g) ascorbic acid was observed in gibberellic acid 600 ppm treated fruits, which was statistically at par with gibberellic acid 500 ppm (470.9 mg/100 g), calcium nitrate 1.0% (470.0 mg/100 g), gibberellic acid 400 ppm (468.3 mg/100 g) and calcium nitrate 2.0% (467.4 mg/100 g) and the lowest (456.2 mg/100 g) was recorded in untreated fruits. The results of present study are in line with the findings of Jayachandran *et al*. (2004) in guava, Rajkumar and Manivanan (2007) in papaya. Bio-conversion of L-ascorbic acid into dehydro-ascorbic acid by of ascorbic acid oxidase enzyme may lead to reduction in ascorbic acid content of fruits (Nayak *et al*., 2011).

Table 2: Effect of post-harvest treatments on ascorbic acid (mg/100 g) and TSS to acid ratio of aonla fruits during storage.

Treatments	Ascorbic acid (mg/100 g)							TSS to acid ratio						
	Storage period (days)													
	2	4	6	8	10	12	Mean	2	4	6	8	10	12	Mean
GA_3 400 ppm	486.2	477.1	469.3	464.6	458.6	454.2	468.3	3.47	3.91	4.33	4.67	4.96	5.27	4.44
GA_3 500 ppm	487.2	478.9	471.8	467.5	462.0	458.1	470.9	3.48	3.89	4.30	4.64	4.93	5.21	4.41
GA_3 600 ppm	487.8	480.0	473.4	469.3	464.2	460.5	472.5	3.49	3.93	4.34	4.68	4.99	5.28	4.45
$Ca(NO_3)_2$ 1%	486.8	478.2	470.9	466.4	460.7	456.7	470.0	3.46	3.90	4.34	4.63	4.93	5.30	4.43
$Ca(NO_3)_2$ 2%	485.8	476.4	468.4	463.5	457.3	452.8	467.4	3.48	3.92	4.32	4.68	4.98	5.29	4.44
$Ca(NO_3)_2$ 3%	484.6	474.3	465.4	460.0	453.1	448.2	464.3	3.51	3.91	4.32	4.67	4.96	5.26	4.44
$KMnO_4$ 1000 mg	484.0	473.3	464.0	458.4	451.3	446.1	462.9	3.47	3.88	4.27	4.63	4.94	5.24	4.41
$KMnO_4$ 2000 mg	484.2	473.6	464.5	458.9	451.9	446.8	463.3	3.46	3.91	4.31	4.63	4.92	5.27	4.42
$KMnO_4$ 3000 mg	484.7	474.4	465.6	460.3	453.5	448.6	464.5	3.48	3.90	4.31	4.64	4.95	5.29	4.43
Bael leaf extract 2%	482.4	470.3	460.0	453.7	445.6	439.9	458.7	3.45	3.86	4.26	4.61	4.91	5.20	4.38
Bael leaf extract 3%	482.6	470.6	460.3	454.1	446.1	440.4	459.0	3.45	3.86	4.26	4.61	4.90	5.20	4.38
Bael leaf extract 4%	482.7	470.8	460.7	454.5	446.5	440.9	459.3	3.46	3.88	4.29	4.64	4.95	5.25	4.41
Control	481.5	468.6	457.6	450.9	442.3	436.2	456.2	3.45	3.86	4.27	4.62	4.92	5.21	4.39
Mean	484.6	474.4	465.5	460.2	453.3	448.4		3.47	3.89	4.30	4.64	4.94	5.25	
CD at 5% level of significance	Treatment (T) = 8.0 Storage period (S) = 5.4 T×S =NS							Treatment (T) = NS Storage period (S) = 0.07 T×S = NS						
	Initial ascorbic acid = 497.4							Initial TSS to acid ratio = 3.01						

Table 3: Effect of post-harvest treatments on organoleptic rating and phenol (%) of aonla fruits during storage.

Treatments	Organoleptic rating							Phenol (%)						
	Storage period (days)													
	2	4	6	8	10	12	Mean	2	4	6	8	10	12	Mean
GA_3 400 ppm	7.6	8.1	8.5	7.6	6.4	4.6	7.1	1.49	1.56	1.66	1.77	1.91	2.07	1.74
GA_3 500 ppm	7.6	8.1	8.5	7.6	6.4	4.7	7.2	1.49	1.55	1.66	1.77	1.9	2.06	1.74
GA_3 600 ppm	7.7	8.2	8.7	7.8	6.6	4.9	7.3	1.48	1.55	1.64	1.75	1.87	2.02	1.72
$Ca(NO_3)_2$ 1%	7.7	8.2	8.7	7.8	6.5	4.8	7.2	1.49	1.55	1.66	1.77	1.9	2.06	1.74
$Ca(NO_3)_2$ 2%	7.6	8.1	8.5	7.6	6.4	4.7	7.2	1.49	1.56	1.67	1.78	1.92	2.09	1.75
$Ca(NO_3)_2$ 3%	7.7	8.1	8.6	7.7	6.5	4.8	7.2	1.49	1.57	1.68	1.8	1.95	2.12	1.77
$KMnO_4$ 1000 mg	7.5	7.9	8.2	7.3	6.1	4.3	6.9	1.5	1.57	1.69	1.82	1.98	2.16	1.79
$KMnO_4$ 2000 mg	7.5	7.8	8.1	7.2	6.0	4.3	6.8	1.49	1.57	1.69	1.82	1.96	2.14	1.78
$KMnO_4$ 3000 mg	7.6	7.9	8.3	7.4	6.2	4.4	7.0	1.49	1.56	1.67	1.79	1.93	2.09	1.76
Bael leaf extract 2%	7.4	7.5	7.7	6.8	5.7	4.0	6.5	1.5	1.58	1.7	1.84	1.99	2.18	1.8
Bael leaf extract 3%	7.4	7.6	7.8	6.9	5.8	4.1	6.6	1.5	1.58	1.7	1.83	1.98	2.16	1.79
Bael leaf extract 4%	7.4	7.6	7.8	6.9	5.8	4.1	6.6	1.5	1.58	1.7	1.84	1.99	2.18	1.8
Control	7.4	7.5	7.7	6.8	5.6	3.8	6.5	1.5	1.58	1.71	1.85	2.01	2.21	1.81
Mean	7.5	7.9	8.2	7.3	6.2	4.4		1.49	1.57	1.68	1.80	1.95	2.12	
CD at 5% level of significance	Treatment (T) = 0.1 Storage period (S) = 0.1 T×S = NS							Treatment (T) = 0.03 Storage period (S) = 0.02 T×S = NS						
	Initial organoleptic rating = 7.2							Initial phenol = 1.43						

D. TSS to acid ratio

The data on TSS to acid ratio in fruits as influenced by different post-harvest treatments have been presented in the Table 2 revealed that the maximum (4.45) TSS to acid ratio was observed in gibberellic acid 600 ppm treated fruits and the minimum (4.38) Bael leaf extract 2% and 3% treated fruits. The increase in total soluble solids and decrease in titratable acidity resulted into enhancement of TSS to acid ratio.

E. Organolepticrating

Organoleptic rating varied significantly among the treatments and it was increased steadily up to 6^{th} day of storage and thereafter it decreased up to the end of storage period as visual quality, flavour and taste declined with the further increase in duration of storage. The highest (7.3) organoleptic rating was observed in gibberellic acid 600 ppm treated fruits, which was statistically at par with calcium nitrate 1.0% (7.3), calcium nitrate 2.0% (7.2), calcium nitrate 3.0% (7.2) and gibberellic acid 500 ppm (7.2), whereas the lowest (6.57) organoleptic rating was observed in untreated fruits. Similar results were also obtained by Singh and Pal (2006) in apple.

F. Phenol (%)

Data presented in Table 3 showed that the minimum (1.72%) phenol was observed in gibberellic acid 600 ppm treated fruits, which was statistically at par with gibberellic acid 500 ppm (1.74%), gibberellic acid 400 ppm (1.74%), calcium nitrate 1.0% (1.74%) and calcium nitrate 2.0% (1.75%), whereas the maximum (1.81%) was recorded in untreated fruits. The total phenols increased with prolongation of storage period in all the treatments. This might be due to either increase in phenylalanine ammonium lyase enzyme, which is responsible for synthesis of phenols or decrease in oxidation of phenol due to reduction in the polyphenoloxidase enzyme activity (Leja *et al*., 2001).

CONCLUSIONS

On the basis of present investigation, it is concluded that among all the treatments, gibberellic acid 600 ppm was proved to be best treatment for maintaining the biochemical attributes of fruits. Fruits treated with gibberellic acid 600 ppm retained excellent titratable acidity and ascorbic acid of fruits. The higher level of total soluble solids (TSS), TSS to acid ratio and organoleptic rating and lower level of phenol content were achieved in gibberellic acid 600 ppm treated fruits, which helps in improving the shelf-life and maintaining acceptable quality of aonla fruits for longer time.

Acknowledgement. We are thankful to all for their expertise and assistance throughout all aspects of our study and for their help in writing the manuscript. We also thank the anonymous referees for their useful suggestions.
Conflict of Interest. None.

REFERENCES

A. O. A. C. (1990). Official Methods of Analysis. 15th Edition. *Association of Official Analytical Chemist*, Washington, D. C.

Amorium, M. V., Dougall, D. K. and Sharp, W. R. (1977). The effect of carbohydrate and nitrogen concentration on phenol synthesis in Paul's Scarlet rose cells grown in tissue culture. *Plant Physiology*, *39*, 91-95.

Arya, R. K. Kumar, P., Dahiya, G. S., Kumar, R., Sutaliya, J. M. and Chhabra, A. K. (2021). Medicinal Garden at a Glance (Publication No. CCSHAU/PUB#21-053), MAP Section, CCS HAU, Hisar.

Bhullar, J. S., Farmahan, H. L. and Agnihotri, R. P. (1981). Studies on storage behaviour and extended shelf life of kinnowmandrian. *Progressive Horticulture*, *13*(3-4), 115-119.

Dhumal, S. S. and Karale, A. R. (2008). Response of aonla fruits stored in zero energy cool chamber to different post-harvest chemicals and packagings. *Annals of Horticulture*, *1*(1), 11-16.

Gomez, K. A., Gomez, A. A. (1981). *Statistical Procedure for Agricultural Research with Emphasis on Rice*. International Rice Research Institute, Los Banos, Philippines.

Goyal, R. K., Patil, R. T., Kingsly, A. R. P., Walia, H. and Kumar P. (2008). Status of post-harvest technology of aonla in India – A review. *American Journal of Food Technology*, *3*, 13-23.

Jayachandran, K. S., Srihari, D., Reddy, Y. N. and Rao, C. L. N. (2004).Influence of post-harvest calcium treatment on storage quality of Lucknow-49 guava. *Crop Research*, *28*(1/3), 60-62.

Leja, M., Mareczek, A., Starzyniska, A. and Roziek, S. (2001). Antioxidant ability of broccoli flower buds during short-term storage. *Food Chemistry*, *72*, 219-222.

Mishra, V., Mishra, P. and Rai, G. K. (2010). Process and product standardization for the development of amla'. *Beverage and Food World*, *34*(6), 58-60.

Nayak, P., Bhatt, D. K., Shukla, D. K. and Kumar, D. (2011). Evaluation of aonla (*Emblica officinalis* G.) segments-in-syrup prepared from stored fruits. *Research Journal of Agricultural Science*, *43*(2), 252-257.

Pathak, P. K., Dwivedi, P. and Kumar, S. (2009). Effect of post-harvest treatments on shelf-life of aonla (*Emblica officinalis*) fruits damaged during harvesting. *Journal of Food Science and Technology*, *43*(3), 283-285.

Rajkumar, M. and Manivannan, K. (2007). Effect of chemicals and growth regulator on storage behavior of papaya (*Carica papaya*). *Acta Horticulturae*, *740*, 327-331.

Ranganna, S. (1977). *Manual of analysis of fruit and vegetable products*. Tata McGraw Hill Publishing Co. Ltd., New Delhi.

Shekhawat, S., Rathore, N. S. and Kaushik, R. A. (2014). Advances in processing and product development of aonla (*Emblica officinalis*) in Indian context-A review. *International Journal of Food and Nutritional Sciences*, *3*(6), 242-247.

Singh, R. K. and Pal, A. A. (2006). Effect of post-harvest application of cycocel, gibberellic acid and calcium chloride on storage behavior of apple during storage. *International Journal of Agricultural Sciences*, *2*(1), 259-260.

Singh, S., Singh, A. K., Joshi, H. K., Bagle, B. G. and Dhandar, D. G. (2009). Evaluation of packages for transportation and storability of aonla (*Emblica officinalis*) under semi-arid environment of Western India. *Journal of Food Science and Technology*, *46*, 127–131.

Thokchom, R. and Mandal, G. (2018). Qualitative analysis of mango cv. Langra influenced by various post-harvest treatments. International *Journal of Chemical Studies*, *7*(1), 2167-2172.

Zomo, S. A., Ismail, S. M., Jahan, M. S., Kabir, K. and Kabir, M. H. (2014). Chemical properties and shelf life of banana (*Musa sapientum* L.) as influenced by different post-harvest treatments. *The Agriculturists*, *12*(2), 06-17.

How to cite this article: Singh Manmohan, Singh Surender, Yadav Bijender Singh and Mayank (2022). Effect of different Post-Harvest Treatments on Biochemical Attributes of Aonla cv. Chakaiya. *Biological Forum – An International Journal, 14*(4): 970-972.