www.ThePharmaJournal.com

The Pharma Innovation

ISSN (E): 2277-7695
ISSN (P): 2349-8242
NAAS Rating: 5.23
TPI 2023; 12(4): 330-334

www.thepharmajournal.com
Received: 06-02-2023
Accepted: 15-03-2023

Manyank
Department of Fruit Science Maharana Pratap Horticultural University, Karnal, Haryana, India

Surender Singh
Department of Fruit Science, Maharana Pratap Horticultural University, Karnal, Haryana, India

Gurmeet Dhatterwal
Department of Horticulture CCS HAU, Hisar, Haryana, India

Avesh
Department of Horticulture, Govt. of Haryana, Haryana, India

Corresponding Author:
Manyank
Department of Fruit Science Maharana Pratap Horticultural University, Karnal, Haryana, India

Effect of packaging material on quality parameters of transported aonla (*Emblica officinalis* Gaertn.) cv. Chakaiya

Manyank, Surender Singh, Gurmeet Dhatterwal and Avesh

Abstract
The present laboratory investigation was aiming to assess the influence of various post-harvest packaging materials on storage behaviour of aonla fruits during the year 2021 in the Department of Horticulture, CCS Haryana Agricultural University, Hisar. Freshly harvested physiological mature fruits of aonla cv. Chakaiya of uniform size, shape, colour, free from disease and bruises were given various post-harvest treatment of packaging material (non-perforated and perforated poly bags, wooden box without cushioning, with newspaper lining, with paddy straw, with newspaper cuttings and Corrugated fibre board boxes with newspaper cuttings and without cutting and plastic crate) during storage of transportation at ambient temperature condition. The data were recorded on total soluble solids, treatable acidity, ascorbic acid content, total soluble solids to acid ratio, phenol content and organoleptic rating. The recorded data were subjected to statistical analysis using Completely Randomized Design (factorial). The non-perforated polybags was found effective in organoleptic rating, which helps in improving the shelf-life of aonla fruits however, wooden box with paddy straw is effective in maintaining a lower level of phenol content and higher level of total soluble solids (TSS), TSS to acid ratio, ascorbic acid, and titratable acidity, which helps in maintaining acceptable quality of aonla fruits for longer time.

Keywords: Aonla, *Emblica officinalis,* packaging material, quality, transportation

Introduction

Aonla (*Emblica officinalis*) is a key ingredient in the Ayurvedic medications Chyavanprash and Trifla in India. The medicinal and therapeutic properties of Aonla are well-known. It is a very nutritious fruit with the highest vitamin C concentration, with 600-900 mg of ascorbic acid per 100 g of pulp, much exceeding that of guava, citrus, and tomato fruits. Apart from Vitamin C it contains other nutrients such as polyphenols, pectin, iron, calcium, and phosphorus (Nath *et al*., 1992) [14] and the Aonla fruit also possesses significant antioxidant properties (Aggarwal and Chopra, 2004) [2].

The aonla fruits are difficult to preserve or transport over long distances due to their perishable nature. There is a loss of 20-25 percent of the fruit before they reach the consumer due to improper handling, packing, transportation, and processing. After harvest, physiological and biochemical changes perdure, rendering the fruit unsuitable for consumption and shortening its shelf life. As a result, long-distance transportation and packaging are two critical elements of the post-harvest chain for fresh horticulture commodities. Appropriate packaging including polyethylene, plastic, paper and fibre board cartons etc. helps to reduce post-harvest losses during transportation, storage, and marketing (Singh *et al*., 1993) [21]. Choosing the right packaging material is as crucial as the packing method. Packaging should be designed in such a manner that it is not only protective but also easy to handle, appealing, and cost-effective. At the moment, packings for aonla fruit is insufficient and underutilized.

Different cushioning materials have distinct capacities to absorb moisture and gases released by the fruits, affecting the fruits' shelf life. Fruits can also be cushioned to prevent them from physiological losses while being transported (Chandra *et al*., 2011) [7]. As a result, packaging for long-distance shipping is an essential component of the post-harvest chain of fresh horticulture products, and its usage for direct selling of fruits to consumers is growing day by day. For the packaging of various fruits, various materials such as polyethylene, plastic, paper boxes, wooden boxes, and corrugated fibre cartons are used, which have numerous advantages such as reduced damage and easier handling, improved sale and profitability, and greater customer convenience.

Keeping these points in the view, the present investigation entitled "Studies on the effect of packaging material on quality during transportation in aonla (*Emblica officinalis* Gaertn.)" was undertaken.

Materials and Methods

The studies on packaging material for aonla during transportation were carried out in the Post-Harvest Laboratory, Department of Horticulture, CCSHAU, Hisar. The physiological mature aonla fruits of Chakaiya cultivar during 4th week of December were procured from Experimental Orchard, Department of Horticulture, CCS Haryana Agricultural University, Hisar. Diseased, undesirable and damaged fruits were sorted out from the samples. Healthy fruits were taken for conducting the experiment and packed in different packaging materials each of 5 kg capacity. The total distance covered for the transportation of aonla was 200 km by road (Hisar to Charkhi Dadri and back to Hisar). The total nine treatments *viz*. P_{1-} Polybags (Non perforated), P_{2-} Polybags perforated, P_{3-} Wooden boxes without cushioning, P_{4-}Wooden boxes with paper linning, P_{5-}Wooden boxes with paddy straw, P_{6-}Wooden boxes with paper cutting, P_{7-} Corrugated fibre board boxes with paper cutting, P_{-8} Corrugated fibre board boxes without paper cutting and P_{9-} Plastic crates were laid out in completely randomized design with three replications. The quality parameters for above said treatments were observed for 2, 4 and 6 days at ambient temperature.

Total soluble solids (^{0}Brix) were determined by using ERMA hand refractometer of the range of 0-32%. Titratable acidity was measured with the help of titration method given in A.O.A.C. (1990) [1]. Ascorbic acid (mg/100g pulp) was estimated acoording to A.O.A.C. (1990) [1]. The results were expressed as mg of ascorbic acid per 100 g of fruit pulp. It was calculated using the following formula:

$$\text{Ascorbic acid (mg/100 g fruit pulp)} = \frac{\text{Titrate value x total volume}}{\text{Standard reading x ml of sample}} \text{ x } 100$$

The total soluble solids to acid ratio were determined by dividing total soluble solids with acidity. Formula used was written below:

$$\text{TSS:Acid} = \frac{\text{Total soluble solids (\%)}}{\text{Titratable acidity (\%)}}$$

The total phenols (%) in the fruit tissue were estimated by method given by Amorium *et al*. (1977) [4] using Folin-ciocalteau's reagent.

Gomez and Gomez (1981) [9] proposed that statistical analysis of collected data during the storage experiment was done by applying the Completely Randomized Design (factorial) for analysis of variance (ANOVA). OPSTAT statistical software was used to conduct the statistical analysis.

Organoleptic rating was determined as per Ranganna (1977) on the basis of colour and appearance, taste, flavor and overall acceptability of the randomly selected fruits by panel of five judges as per 'Hedonic Scale' (1-9 points) which is as follows *viz*. 9: Extremely desirable, 8: Very much desirable, 7: Moderately desirable, 6: Slightly desirable, 5: Neither desirable nor undesirable, 4: Slightly undesirable, 3: Moderately undesirable, 2: Very much undesirable and 1: Extremely undesirable.

Results and Discussion

Total soluble solids (°Brix)

Results in Table 1 revealed that the packaging materials had a significant influence on total soluble solids following transportation throughout storage. Fruits packed in wooden box with paddy straw had the highest (7.77^{0}Brix) total soluble solids among all the treatments, which was at par with wooden box without cushioning (7.69^{0}Brix), plastic crate (7.63^{0}Brix) and corrugated fibre board boxes without cuttings (7.60^{0}Brix). The minimum (7.43^{0}Brix) total soluble solids were found to be present in the fruits packed in perforated polybags. The observations recorded for the total soluble solids were significantly distinguishable with the storage time. The minimum (7.21^{0}Brix) total soluble solids were found on the second day of storage whereas; sixth day of storage recorded the maximum (7.91^{0}Brix) total soluble solids. The rise in TSS in fruit might be attributed to polysaccharide hydrolysis and a slower rate of sugar consumption in the respiration process as a result of the changed environment in the packing material during fruit storage. The change of pectic compounds, starch, hemicellulose, and other polysaccharides into soluble sugar, as well as the drying of fruits, may cause an increase in TSS during storage (Hoda *et al* 2000, Singh *et al* 2003) [11, 18].

Titratable Acidity (%)

The titratable acidity (%) of aonla fruits packed in various packaging materials decreased with the passage of time (Table 1). Fruits packed in wooden boxes with paddy straw had the highest (1.81%) titratable acidity, which was at par with fruits packed in wooden boxes without cushioning (1.80%), plastic crates (1.79%) and corrugated fibreboard boxes without cuttings (1.78%) while, the perforated polybags recorded the lowest (1.75%) acidity. Significant differences were observed for the titratable acidity with the storage time *i.e*. maximum (1.89%) on second day and minimum (1.67%) on sixth day. The conversion of organic acids into sugars and their derivatives, or their use in respiration in aonla, might be linked to the decrease in titratable acidity during storage (Singh *et al* 2003, Singh *et al* 2005) [18, 9]. The use of numerous organic acids contained in the vacuole of cells during various metabolic activities such as respiration might explain the decrease in acidity (Panda *et al*., 2017) [17]. Alam *et al*. (2014) [3] recorded the minimum titratable acidity on 8th day of storage in litchi fruits without stalks packed in corrugate fibreboard boxes cushioned with green cassia leaves.

Ascorbic Acid (mg/100 g pulp)

The results in Table 1 clearly show that the ascorbic acid (mg/100 g pulp) content in aonla fruits declined with in successive increment of storage period. The highest (472 mg/100 g pulp) concentration of ascorbic acid was found in wooden boxes with paddy straw, which was observed to be statistically at par with the ascorbic acid present in the fruits packed with wooden boxes without cushioning (468.6 mg/100 g pulp), plastic crate (466.5 mg/100 g pulp), corrugated fibre board boxes without cuttings (465.2 mg/100 g pulp) and wooden boxes with newspaper cuttings (461.1 mg/100 g pulp). This might be attributed by ascorbic acid's oxidation and irreversible conversion to dehydro ascorbic acid in the presence of the ascorbinase enzyme. (Panda *et al*., 2017) [17]. Oxidizing enzymes such as ascorbic acid oxidase, peroxidase, catalase, and polyphenol oxidase may cause a reduction in the ascorbic acid concentration in aonla fruits during storage

(Singh *et al.* 2005) [9]. The lowest ascorbic acid (450.5 mg/100 g pulp) concentration was found in fruits packed in perforated poly bags. Storage period was also found to be statistically significant with the maximum (470.1 mg/100 g pulp) on the second day of storage and minimum (453.4 mg/100 g pulp) on sixth day of storage. Litchi fruits with stalks packed in corrugate fibreboard boxes cushioned with green cassia leaves had the maximum concentration of ascorbic acid at the end of experiment (Alam *et al.*, 2014) [3].

Total soluble solids to acid ratio

The ratio of total soluble solids to acid increased in fruits during storage (Table 1). The wooden box with paddy straw treatment had the highest (4.32) total soluble solids to acid ratio, which was followed by the wooden box without cushioning and wooden box with newspaper lining (4.30). Perforated polybags and corrugated fibre board boxes with newspaper cuttings packing recorded the lowest (4.27) TSS to acid ratio. Storage had a substantial impact on the average total soluble solids to acid ratio regardless of packing material. On the 2nd day of storage, the total soluble solids to acid ratio value were found to be lowest (3.82) whereas, on 6th day of storage, the total soluble solids to acid ratio were found to be highest (4.75). It might be attributed to a rise in total soluble solids due to polysaccharide hydrolysis and a reduction in acidity due to the usage of organic acid in respiration during storage. The afore mentioned investigation confirm the findings of Subedi *et al.* (2017) [23] who showed greater ratio of total soluble solids to acid (74.4) in apple packed in 3 Ply Beer cartons.

Phenol (%)

The data (Table 1) on phenol content as a function of various packaging material reveals that there is a significant difference among the treatments. The wooden box with paddy straw had the minimum phenol content (1.46) among all the packing materials which was found at par with the wooden box without cushioning (1.49) whereas, maximum (1.61) amount of phenol content was recorded for perforated polybags. All the treatments differed significantly with respect to storage period. Where, the maximum (1.62) phenol content was observed on 6th day of storage and minimum (1.46) on 2nd day of storage. This might be due to either increase in phenylalanine ammonium lyase, which is responsible for synthesis of phenols or decrease polyphenoloxidase enzyme activity which oxidize the phenol (Leja *et al.*, 2001) [13]. Similar results regarding increasing trend of total phenol were presented by Singh and Kumar (2000) [22], Neeraj *et al.* (2002) [16] and Gupta and Mukherjee (1982) [10] in aonla and Ayala-Zavala *et al.* (2004) [6] in strawberry.

Organoleptic Rating

The organoleptic rating of aonla fruits show a decreasing trend with the increasing storage period irrespective of the packaging material (Table 1). Aonla fruits packed in non-perforated polybags received the highest (7.9) organoleptic rating, which was at par with fruit packed in corrugated fibreboard boxes with newspaper cuttings (7.8) whereas. Storage time showed a substantial impact on the organoleptic grade of aonla fruits regardless of packing choices. On the second day of storage, the highest (8.2) organoleptic rating was recorded while, the lowest (6.3) organoleptic rating was received on the sixth day of storage. According to Fassema *et al.* (2011) [8], organoleptic rating declined over time, however corrugated fibreboard and hardwood boxes were found to be the best at maintaining organoleptic rating in kinnow mandarin and sweet orange, respectively. According to Kaur *et al.* (2014) [12], guava fruits packaged in 5% perforated LDPE film and preserved in corrugated fibreboard boxes may be sustained for 14 days with good organoleptic grade at a temperature of 6-8 °C and a relative humidity of 90-95%. According to Avesh *et al.* (2019) [5], various packaging materials have showed a declining trend in organoleptic quality of guava fruits.

Table 1: Effect of different packaging materials on different quality traits during storage of transported aonla cv. Chakaiya

Treatments	Polybags		Wooden box				Corrugated fibre board boxes		Plastic crate	Mean
Storage period (days)	Non-perforated	Perforated	Without cushioning	With newspaper lining	With paddy straw	With newspaper cuttings	With newspaper cuttings	Without cuttings		
Total soluble solids (^{0}Brix)										
2	7.17	7.13	7.28	7.18	7.32	7.20	7.14	7.23	7.24	7.21
4	7.52	7.45	7.71	7.54	7.79	7.56	7.46	7.62	7.65	7.59
6	7.82	7.72	8.08	7.85	8.19	7.88	7.73	7.96	7.99	7.91
Mean	7.50	7.43	7.69	7.52	7.77	7.55	7.44	7.60	7.63	-
CD at 5% level of significance Packing material (P) = 0.18 Storage period (S) = 0.11 P×S=NS Before transportation fruit TSS = 6.65										
Titratable Acidity (%)										
2	1.88	1.87	1.90	1.87	1.91	1.88	1.87	1.89	1.90	1.89
4	1.75	1.74	1.80	1.75	1.80	1.76	1.74	1.77	1.78	1.77
6	1.65	1.64	1.70	1.65	1.71	1.66	1.64	1.67	1.68	1.67
Mean	1.76	1.75	1.80	1.76	1.81	1.77	1.75	1.78	1.79	-
CD at 5% level of significance: Packing material (P) = 0.04 Storage period (S) = 0.03 P×S=NS Before transportation fruit Titratable acidity = 2.06										
Ascorbic Acid (mg/100 g pulp)										
2	464.4	460.9	476.4	468.4	479.3	470.0	463.7	473.5	474.6	470.1
4	453.5	449.3	467.7	458.3	471.2	460.1	452.6	464.3	465.6	460.3
6	445.9	441.3	461.7	451.1	465.5	453.2	444.9	457.8	459.3	453.4
Mean	454.6	450.5	468.6	459.2	472.0	461.1	453.7	465.2	466.5	-
CD at 5% level of significance: Packing material (P) = 11.5 Storage period (S) = 6.7 P×S=NS Before transportation fruit firmness = 551.3										
Total soluble solids to acid ratio										
2	3.81	3.81	3.83	3.84	3.83	3.83	3.82	3.83	3.81	3.82
4	4.30	4.28	4.28	4.31	4.33	4.30	4.29	4.31	4.30	4.30

6	4.74	4.71	4.75	4.76	4.79	4.75	4.71	4.77	4.76	4.75
Mean	4.28	4.27	4.30	4.30	4.32	4.29	4.27	4.29	4.29	-
CD at 5% level of significance: Packing material (P) =0.12Storage period (S) = 0.08 P×S=NS Before transportation fruit firmness = 3.23										
Phenol (%)										
2	1.49	1.51	1.43	1.48	1.41	1.46	1.50	1.44	1.43	1.46
4	1.57	1.60	1.49	1.55	1.46	1.54	1.58	1.52	1.50	1.53
6	1.66	1.71	1.56	1.64	1.52	1.62	1.68	1.59	1.57	1.62
Mean	1.57	1.61	1.49	1.56	1.46	1.54	1.59	1.52	1.50	-
CD at 5% level of significance: Packing material (P) = 0.04 Storage period (S) = 0.02 P×S =NS Before transportation total phenol = 1.41										
Organoleptic Rating										
2	8.6	8.1	7.8	8.3	8.1	8.3	8.5	8.2	7.6	8.2
4	8.5	7.9	7.7	8.1	7.9	8.1	8.4	8.1	7.5	8.0
6	6.7	6.3	6.1	6.2	6.3	6.4	6.5	6.4	6.1	6.3
Mean	7.9	7.4	7.2	7.5	7.4	7.6	7.8	7.6	7.1	-
CD at 5% level of significance: Packing material (P) = 0.18 Storage period (S) = 0.11 P×S=NS Before transportation fruit Organoleptic Rating = 7.2										

Conclusion

The non-perforated polybags was found effective in organoleptic rating, which helps in improving the shelf-life of aonla fruits however, wooden box with paddy straw is effective in maintaining a lower level of phenol content and higher level of total soluble solids (TSS), TSS to acid ratio, ascorbic acid, and titratable acidity, which helps in maintaining acceptable quality of aonla fruits for longer time.

References

1. AOAC. Official Methods of Analysis. 15th Edition, Association of Official Analytical Chemist, Washington, D. C; c1990.
2. Agarwal S, Chopra CS. Studies on changes in ascorbic acid and total phenols in making aonla products. Bev. Food World. 2004;31(5):32-33.
3. Alam M, Singh JP, Yadav SK, Siddiqui MW. Screening packaging and biologically active cushioning materials for post-harvest storage of litchi. Journal of Post-harvest Technology. 2014;2(4):195-207.
4. Amorium MV, Dougall DK, Sharp WR. The effect of carbohydrate and nitrogen concentration on phenol synthesis in Paul's Scarlet rose cells grown in tissue culture. Plant Physiology. 1977;39:91-95.
5. Avesh, Singh S, Rana MK, Nain S. Effect of packaging materials on physiological parameters of guava (*Psidium guajava* L.) cv. Hisar Safeda during storage after transportation. Journal of Pharmacognosy and Phytochemistry. 2019;1:40-44.
6. Ayala-Zavala AF, Wang SY, Wang CY, Gonzalez-Aguilar GA. Effect of storage temperatures on antioxidant capacity and aroma compounds in strawberry fruit. Lebensm.-Wiss. u.-Technology. 2004;37:687-695.
7. Chandra D, Kumar R, Misra KK. Effect of low cost wrapping and cushioning materials on physico-chemical properties of guava (*Psidium guajava* L.) fruits. Progressive Horticulture. 2011;43(1):130-133.
8. Fassema J, Abu JO, Alakali JS. Effect of packaging and storage condition on the quality of sweet orange (*Citrus sinensis*). Journal of Agricultural Technology. 2011;7(3):797-804.
9. Gomez KA, Gomez AA. Statistical Procedure for Agricultural Research with Emphasis on Rice. International Rice Research Institute, Los Banos, Philippines; c1981.
10. Gupta VK, Mukherjee D. The influence of wax emulsion, morphactin and gibberellic acid on storage behaviour of Indian gooseberry fruits. Scientia Horticulture. 1982;16:155-162.
11. Hoda MN, Yadav GS, Singh S, Singh J. Storage behaviour of mango hybrids. Indian J Agric. Sci. 2000;71:469-472.
12. Kaur S, Arora NK, Gill MIS, Boora RS, Mahajan BVC, Dhaliwal HS. Effect of perforated and non-perforated films on quality and storage life of guava fruits. Indian Journal of Horticulture. 2014;71(3):390-396.
13. Leja M, Marezek A, Ben J. Antioxidant properties of two apple cultivars during long-term storage. Food Chem. 2003;80:303-307.
14. Nath V, Singh IS, Kumar S. Evaluation of aonla cultivars for their shelf-life at ambient temperature. Narendra. Deva. J Agri. Res. 1992;7(1):117.
15. Neeraj KS, Kumar J. Effect of HDPE, LDPE and PVC plastic packaging on the ascorbic acid content and decay loss during storage of aonla fruits (*Emblica officinalis* Gaertn) cv. Chakaiya. Haryana J Hort. Sci. 2004;33:213-215.
16. Neeraj Kumar SK, Kumar J, Godara RK. Effect of different types of plastic bags and their thickness on shelf life of Aonla. Haryana J Horticulture Science. 2002;31(3-4):180-184.
17. Panda AK, Goyal RK, Sharma VK. Physico-chemical properties of strawberry under super market storage condition with passive modified atmospheric packaging. Environment and Ecology. 2017;35(2A):803-807.
18. Singh S, Singh AK, Joshi HK. Storage behaviour of Indian gooseberry (*Emblica officinalis* Gaertn) under semi-arid ecosystem of Gujarat. Indian J Agric Sci. 2003;73:530-534.
19. Singh S, Singh AK, Joshi HK. Prolonging storability of Indian gooseberry under semi-arid ecosystem of Gujarat. Indian J Agric. Sci. 2005;75:647-650.
20. Singh D, Singh R, Bhatt F. Development, quality evaluation and shelf life studies of whey guava beverage. International Journal of Current Engineering and Technology. 2014;4(3):2171-2175.
21. Singh IS, Pathak RK, Dwivedi R, Singh HK. Aonla production and post-harvest technology, N.D. Univ. Agric. Technol. Kumarganj, Tech. Bull Fakirabad, India, 1993.
22. Singh R, Kumar S. Studies on the effect of post-harvest treatments on decay loss and biochemical changes during storage of aonla (*Emblica officinalis* G.) fruit cv. Chakaiya. Haryana J of Hort. Sci. 2000;29(3-4):178-179.
23. Subedi GD, Gautam DMD, Baral R, GBKC, Paudyal KP, Giri RK. Evaluation of packaging materials for transportation of apple. Nepalese Journal of Agricultural Sciences. 2017;15:166-176.