Biological Forum – An International Journal **15(4): 83-87(2023)**

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

Effect of Packaging Materials on Shelf-Life of Transported Aonla (*Emblica officinalis* Gaertn.) cv. Chakaiya

Mayank[1], Singh Surender[1*] and Dhatterwal Gurmeet[2]
[1]Department of Fruit Science,
Maharana Pratap Horticultural University, Karnal (Haryana), India.
[2]Department of Horticulture, CCS HAU, Hisar (Haryana), India.

(Corresponding author: Singh Surender[*])
(Received: 11 February 2023; Revised: 26 February 2023; Accepted: 09 March 2023; Published: 20 April 2023)
(Published by Research Trend)

ABSTRACT: Owing to perishable nature of aonla fruits and improper handling, packing, transportation and processing, about 20-25 per cent losses occur before the fruits reach the consumer. In this context, an experiment on the effect of packaging material on shelf-life during transportation of aonla (*Emblica officinalis* Gaertn.) was conducted at CCS Haryana Agricultural University, Hisar during 2020-21. The study was aiming to assess the influence of various post-harvest packaging materials on storage behaviour of aonla fruits. Freshly harvested physiological mature fruits of aonla cv. Chakaiya of uniform size, shape, colour, free from disease and bruises were given various post-harvest treatments of packaging material (non-perforated and perforated poly bags, wooden box without cushioning, with newspaper lining, with paddy straw, with newspaper cuttings and corrugated fiber board boxes with newspaper cuttings and without cutting and plastic crate) during storage of transportation at ambient temperature condition. The data were recorded on physiological loss in weight, decay loss, fruit firmness, change in colour, injury. The non-perforated polybags was found effective in reducing physiological loss in weight, decay loss and retaining a higher level of fruit firmness, color, which helps in improving the shelf-life of aonla fruits for longer time and corrugated fiber board box with newspaper cuttings was found effective in reducing the injury level to a greater extent. Hence, non-perforated polybags, wooden box with paddy straw and corrugated fibreboard box with newspaper cuttings seem to have the potential to enhance the post-harvest life of aonla.

Keywords: Aonla, *Emblica officinalis,* packaging material, shelf-life**,** transportation.

INTRODUCTION

Aonla (*Emblica officinalis* Gaertn. Syn. *Phyllanthus emblica*) is an important indigenous fruit of the Indian subcontinent. Aonla has become a highly significant fruit due to its resistant character, high yield and adaptability for diverse wastelands, nutritional and medicinal benefits. 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 100g 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) and the aonla fruit also possesses significant antioxidant properties (Frei *et al.*, 1989). It has long been used for medicinal purposes and is commonly suggested for its synergistic benefits in both the ayurveda and unani medical systems (Agarwal and Chopra 2004).

It's a key ingredient in the Ayurvedic medications Chyavanprash and Trifla in India. It has long been used for medicinal purposes and is commonly suggested for its synergistic benefits in both the ayurveda and unani medical systems (Agarwal and Chopra 2004). Aonla fruits can be stored safely by dipping in 600 ppm solution of gibberellic acid (Singh *et al.*, 2022).

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. From 35 days old to fully developed fruit (120 days), quality metrics (such as specific gravity, TSS, acidity, TSS to acid ratio, fiber content, and so forth) rise linearly, thus harvesting fruits at 120 days after set is optimal (Shivakumar and Sundaram 2010). Appropriate packaging helps to reduce post-harvest losses during transportation, storage, and marketing (Singh *et al.*, 1993). Packing is done in baskets made of pigeon pea twigs (40-45 kg capacity), coated with newspaper and cushioned with aonla leaves (Pathak *et al.*, 1989). Gunny bags with a capacity of 50 kg to 100 kg are commonly used. However, the fruits in these gunny sacks are damaged by impact, vibration, and compression during transit.

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). 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 view, the present investigation ''Effect of packaging material on shelf-life during transportation in aonla (*Emblica officinalis* Gaertn.) var. Chakaiya"was undertaken.

MATERIALS AND METHODS

The experiment was conducted in the Post-harvest Laboratory, Department of Horticulture, College of Agriculture, CCSHAU, Hisar during 2020-21. The methods employed during the course of investigation and material utilized has great significance in the research program. The experimental studies were carried out on packaging material for aonla during transportation. The aonla fruits were collected from horticulture farm, CCS Haryana Agricultural University, Hisar. The fruits of Chakaiya cultivar were harvested at physiological maturity during 4th week of December. 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 (CRD) with three replications. The storage of above said treatments was carried out for 2,4 and 6 days at ambient temperature.

The observation were recorded at an alternate days at room temperature. Fruits were subjected to different physiological and biochemical observations mentioned as under:

The Physiological loss of weight (PLW) of fruit was determined on the basis of initial weight. After each interval of storage, the weight of fruit was recorded and percent physiological loss in weight (PLW) was calculated by subtracting final weight from the Initial weight of fruits, as per formula given below:

$$\text{PLW}(\%) = \frac{\text{Initial weight (g)} - \text{final weight (g)}}{\text{Initial weight (g)}} \times 100$$

Decay loss (%) of fruits was decided on the basis of visual observations. Decay loss was evaluated by simply counting the number of spoiled fruits displaying fungal infection and subsequent rotting in a replication and expressed in percentage.

$$\text{Decay loss}(\%) = \frac{\text{Number of spoiled fruits}}{\text{Total number of fruits}} \times 100$$

Firmness was measured by penetrometer, using cylindrical plunger probe of 4mm. The firmness was measured from a side of the equatorial region of the fruit. Firmness of fruit was measured and expressed in Kg/cm^2. The change in colour during the entire storage period was determined on visual basis and a specific tag is given to different colours *viz*., Yellowish green, Greenish yellow, Light yellow, Yellow, and Brownish yellow.

The injury was calculated after transportation of fruits in different packaging materials. Number of injured fruits was counted from the packs and expressed in percent.

$$\text{Injury}(\%) = \frac{\text{Number of injured fruits}}{\text{Total number of fruits}} \times 100$$

RESULTS AND DISCUSSION

Physiological loss in weight (%). It is evident from the data in Table 1 that packing and storage had a substantial impact on physiological weight loss.

After six days of storage, fruits packed in non-perforated poly bags lost the least (3.04%) amount of weight, which followed by fruits packed in perforated polybags (3.29%) while, the fruits packed in wooden boxes without cushioning lost the highest (6.83%) weight. Minimum (2.03%) weight loss was observed on the second of storage while, maximum (8.69%) loss in weight was observed on the sixth day of storage. On second day of storage, non-perforated polybags showed the least (1.57%) loss in weight which was at par with all the packaging materials except the packaging material namely polybags perforated, wooden box without cushioning and plastic crates. Sharma and Singh (2010) also reported that there was increase in physiological loss in weight of apple fruits placed in non-perforated poly bags recorded the least physiological weight loss (3.04%), which might be related to the creation of a high humid environment within the sealed poly bags, which slowed the rate of water loss from the fruit surface via transpiration. These results are supported by those of Baviskar *et al.* (1995); Avesh *et al.* (2019), who observed the maximum physiological loss in the weight of control fruits and the least in guava fruits packed in polyethylene. Rana *et al.* (2018) who recommended that the individual packing of guava fruits in polyethylene films reduced the physiological loss in weight.

Decay loss (%). It is observed from the Table 1 that decay loss was significantly varied among the treatments and lowest (6.51%) decay loss was observed in the fruits packed in non-perforated polybags, which was followed by the fruits packed in corrugated fibre board boxes with newspaper cuttings (6.82%) and the highest (16.67%) decay loss was observed in the fruits packed in plastic crate. Storage period also had significant effect on the spoilage of fruits, irrespective of treatments. During storage period, the highest (15.53%) decay loss was observed on the 6th day of storage, while the lowest (5.85%) was observed on 2nd day of storage. The interaction between treatments and storage time was found to be significant. The fruits packed in corrugated fibre board boxes with newspaper cuttings showed the minimum (2.27%) decay loss on the 2nd day of storage, which was at par with fruits packed in non-perforated polybags (2.44%) and the maximum (22.74%) was observed in fruits packed in plastic crates on 6th day of storage. The decay loss in aonla fruits increased with the increasing storage time regardless of the packing material used due to the spoilage of fruit caused by various fungal diseases during extended storage (Jeffries *et al*., 1990; Crane and Campbell 1991; Eckert *et al*., 1996). Panda *et al*. (2017) also found that film packaging had a significant effect on maintaining high humidity and reducing water loss from produce at room temperature, and that these favourable circumstances were responsible for reducing fruit deterioration.

Fruit firmness (lbf). Table 1 shows the results on fruit firmness in all the treatments differed significantly among themselves. Aonla fruits packed in non-perforated poly bags had the highest (14.94 lbf) firmness, which was at par with fruits packed in perforated poly bags (14.74 lbf) and the fruits packed in wooden box without cushioning had the lowest (13.05 lbf) firmness. Maximum (14.58 lbf) fruit firmness was observed on the second day of storage and minimum (13.50 lbf) was perceived on sixth day of storage. On a mean data basis, the interaction between packing materials and storage was determined to be non-significant.

Kaur *et al*. (2013) who claimed that pear firmness declined with time during storage. The maximum firmness was observed by the aonla fruits packed in non-perforated polybags (14.94 lbf), which was at par with aonla fruits packed in perforated poly bags (14.74 lbf) irrespective of storage period. It might be due to the higher concentration of carbon dioxide and low concentration of oxygen inside the package, which led to slow ripening and respiration, therefore, the fruits retained their firmness due to slow ripening process. The present findings are also supported by Rose *et al*. (2016) who reported that throughout the storage period, mango fruits packed in 150 gauge polypropylene bags with 1% ventilation exhibited the maximum firmness.

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

Treatments / Storage period (days)	Polybags		Wooden box				Corrugated fibre board boxes		Plastic crate	Mean
	Non-perforated	Perforated	Without cushioning	With newspaper lining	With paddy straw	With newspaper cuttings	With newspaper cuttings	Without cuttings		
Physiological loss in weight (%)										
2	1.57	1.82	4.84	1.74	1.72	1.70	1.62	1.64	1.66	2.03
4	3.22	3.43	6.95	5.85	6.21	5.92	3.76	3.86	5.81	5.00
6	4.32	4.62	8.69	7.10	7.62	7.20	5.03	5.32	7.05	6.33
Mean	3.04	3.29	6.83	4.90	5.18	4.94	3.47	3.61	4.84	-
	CD at 5% level of significance: Packing material (P) = 0.12 Storage period (S) = 0.07 P×S=0.21									
Decay loss (%)										
2	2.44	4.65	9.30	6.67	6.82	4.76	2.27	4.35	11.37	5.85
4	7.32	9.30	11.63	11.11	11.37	9.53	6.82	10.87	15.92	10.43
6	9.76	16.29	18.61	17.78	15.92	14.29	11.37	13.05	22.74	15.53
Mean	6.51	10.08	13.18	11.86	11.37	9.53	6.82	9.42	16.67	-
	CD at 5% level of significance : Packing material (P) = 0.25 Storage period (S) = 0.14 P×S =0.44									
Firmness (lbf)										
2	15.28	15.18	13.68	14.75	14.11	14.25	15.07	14.81	14.10	14.58
4	15.11	14.83	13.00	13.71	13.36	13.53	14.46	14.31	13.64	13.99
6	14.45	14.22	12.48	13.27	13.02	13.12	13.97	13.72	13.32	13.50
Mean	14.94	14.74	13.05	13.91	13.49	13.63	14.50	14.28	13.68	-
	CD at 5% level of significance: Packing material (P) = 0.35 Storage period (S) = 0.20 P×S =NS Before transportation fruit firmness = 16.53									
Change in colour										
0	YG	YG	YG	YG	YG	YG	YG	YG	YG	-
2	GY	GY	GY	GY	GY	GY	GY	GY	GY	-
4	GY	LY	Y	LY	LY	LY	GY	GY	Y	-
6	LY	Y	Y	Y	Y	Y	LY	LY	Y	-
Injury (%)										
2	1.44	4.35	5.05	4.84	4.28	4.18	0.65	3.49	6.21	3.83
	CD at 5% level of significance: Packing material (P) = 0.21									

Change in colour. The perusal of data in Table 1 shows that the colour of the fruit changes during storage of transported aonla. The colour of the fruits in all packaging was yellowish green before transportation, but it turned to greenish yellow after transportation on the second day of storage. Light yellow colour was observed for the fruits packed in non-perforated polybags, corrugated fiberboard boxes with newspaper cuttings and corrugated fiberboard boxes without newspaper cuttings, which were found to be superior than the fruits wrapped in other packaging materials towards the end of storage, all fruits became yellow. The colour change during storage might be due to higher carbon dioxide and low oxygen concentrations inside the packages, reducing the activities of enzymes involved in breakdown and constructive processes (Bhattarai and Shah 2018). Kaur *et al*. (2014) also reported that compared to perforated polypropylene film, guava fruits packed in non-perforated polypropylene film maintained their green colour. Hailu *et al.* (2014) also reported that under ambient room circumstances, banana fruits packed in 300 gauge LDPE bags retained the highest amount of greenness for 30 days.

Injury (%). Table 1show that the various packaging materials had a substantial impact on the per cent damage during transit. Fruits packed in corrugated fiberboard box with newspaper cuttings were found to have the least (0.65%) injury, which was followed by fruits packed in non-perforated polybags (1.44%) however, fruits packed in plastic crate (6.21%) were found to have the maximum injury. It might be because newspaper clippings are cut into corrugated fiberboard boxes with appropriate strength and sufficient shock bearing capability, preventing abrasion and bruising during long distance transportation on bad roads. According to Dharmasena and Sarananda (2012), cuts, vibrations, abrasion, compression and impacts are the main causes of mechanical damages to occur during handling and transportation. The results obtained are in conformity with the results of Joshi *et al*. (1988) who reported that Red Delicious apple bruise losses were reduced by using corrugated fiberboard packaging. Vursavus and Ozguven (2004) who also suggested that cushioning materials can be used to prevent fruit damage during transit. Singh *et al.* (2014) also found that corrugated fiberboard boxes were shown to be the most effective for minimizing mechanical damage in guava.

CONCLUSIONS

The non-perforated polybags was found effective in reducing physiological loss in weight, decay loss and retaining a higher level of fruit firmness, color, which helps in improving the shelf-life of aonla fruits for longer time and corrugated fiberboard box with newspaper cuttings was found effective in reducing the injury level to a greater extent. Hence, non-perforated polybags, wooden box with paddy straw and corrugated fiber board box with newspaper cuttings seem to have the potential to enhance the post-harvest life of aonla.

FUTURE SCOPE

The study on effect of packaging materials on shelf-life of aonla during transportation can further be conducted for more distance and other packing materials.

Acknowledgement. We are thankful to Head, Department of Horticulture CCS HAU Hisar for providing all necessary facilities to carry out the experiment. We also thank the anonymous referees for their useful suggestions.
Conflict of Interest. None.

REFERENCES

Agarwal, S. and Chopra, C. S. (2004). Studies on Changes in Ascorbic Acid and Total Phenols in Making Aonla Products. *Beverage and Food World*, *31*(5), 32–33.

Avesh, Singh, S., Rana, M. K. and Sharma, J. R. (2019). Effect of Packaging Materials on Physiological Parameters of Guava (*Psidium guajava* L.) cv. Hisar Safeda During Storage After Transportation. *International Journal of Chemical Studies, 7*(3), 2875-2879.

Baviskar, M. R., Waskar, D. P. and Kaulgud, S. N. (1995). Effect of Various Post-harvest Treatments on Shelf life and Quality of Ber Fruit. *Indian Journal of Horticulture*, *52*(1), 37-45.

Bhattarai, B. P. and Shah, R. (2018). Effect of Different Packaging Materials on Post-Harvest Status of Mandarin (*Citrus reticulata* Blanco). *Journal of Horticulture,* 4, 4.

Chandra, D., Kumar, R. and Misra, K. K. (2011). Effect of Low cost Wrapping and Cushioning materials on Physico-chemical Properties of Guava (*Psidium guajava* L.) Fruits. *Progressive Horticulture*, *43*(1), 130-133.

Crane, J. H. and Campbell, C. W. (1991). The Mango. Florida Cooperative Extension Service, Institute of Food and Agricultural Science, University of Florida, USA.

Dharmasena, D. A. N. and Sarananda, K. H. (2012). Present status, Issus and Future trends in Fruit and Vegetable Handling, Distribution and Marketing in Sri Lanka, Workshop on Postharvest Technology and Cold Chain Management, 20-22 March, 2012, Amity International Centre for Postharvest Technology and Cold Chain Management, Noida, India.

Eckert, J. W., Ratnayake, M., Sievert, J. R. and Strange, R. R. (1996). Curing Citrus Fruit to Control Postharvest Diseases. In: Proceedings of VIII Congress of the International Society of Citriculture, Sun City, South Africa, p. 48.

Frei, B., England, L. and Ames, B. (1989). Proceedings of Natural Academic Sciences, USA. *86,* 6377–6381.

Hailu, M., Workneh, T. S. and Belew, D. (2014). Effect of Packaging materials on Shelf life and Quality of Banana cultivars (*Musa* spp.). *Journal of Food Science and Technology*, *51*(11), 2947-2963.

Jeffries, P., Dodd, J. C., Jeger, M. J. and Plumbley, R. A. (1990). The biology and control of Colletotrichum species on tropical fruit crops. *Journal of Plant Pathology*, *39*, 343-366.

Joshi, K. R., Seth, J. N. and Shukla, S. (1988). Effect of Different packaging Cases on Transportation and Marketing Quality of Red Delicious Apple. *Progressive Horticulture, 20*(3-4), 200-202.

Kaur, K., Dhillon, W. S. and Mahajan, B. V. C. (2013). Effect of Different packaging aterials and Storage Intervals on Physical and Biochemical

Characteristics of Pear. *Journal of Food Science and Technology, 50*(1), 147-152.

Kaur, S., Arora, N. K., Gill, M.I.S., Boora, R. S., Mahajan, B.V.C. and Dhaliwal, H. S. (2014). Effect of Perforated and Non-perforated Films on Quality and Storage life of Guava Fruits. *Indian Journal of Horticulture, 71*(3), 390-396.

Nath, V., Singh, I. S. and Kumar, S. (1992). Evaluation of Aonla cultivars for Their Shelf-life at Ambient Temperature. *Narendra Deva Journal of Agriculture Research, 7*(1), 117.

Panda, A. K., Goyal, R. K. and Sharma, V. K. (2017). Physico-chemical Properties of Strawberry under super market storage condition with passive modified atmospheric packaging. *Environment and Ecology, 35*(2A), 803-807.

Pathak, R. K., Om, H. and Dwivedi, R. (1989). Collection, Maintenance and Evaluation of Aonla (*Emblica officinalis* Gaertn) Germplasm. *Indian Journal of Plant Genetic Resources*, *2*(1), 84-86.

Rana, S., Siddiqui, S. and Gandhi, K. (2018). Effect of Individual Vacuum and Modified Atmosphere Packaging on Shelf life of Guava. *International Journal of Chemical Studies, 6*(2), 966-972.

Rose, K. S., Kumar, A. K., Lakshmi, B. K. M. and Padmavathamma, A. S. (2016). Effect of Polypropylene Packaging and Ethrel Treatment on Shelf life and Quality of Mango cv. Suvarnarekha. *International Journal of Tropical Agriculture, 34*(5), 1355-1358.

Sharma, R. R. and Singh, D. (2010). Effect of Different Packaging materials on Shelf life and Qualiy of Apple During Storage. *Indian Journal of Horticulture, 67*(1), 94-101.

Shivakumar, V. and Sundaram, K. S. (2010). Effect of Different Maturity Stage on Fruit Quality Traits or Physiochemical Characters of Aonla cv. *NA-7. Plant Archives, 10*(2), 903-905.

Singh, I. S., Pathak, R. K., Dwivedi, R. and Singh, H. K. (1993). Aonla Production and Post-harvest Technology, N. D. University of Agriculture Technology, Kumarganj, Technical Bulletin Faizabad, India.

Singh, M., Singh, S., Yadav B. S. and Mayank (2022). Effect of Different Post-harvest Treatments on Biological Attributes of Aonla cv. Chakaiya. *Biological Forum-An International Journal*, *14*(4), 969-972.

Singh, P., Singh, S., Singh, B.R. and Mishra, D. K. (2014). Standardization of Packaging for Transportation of Guava Fruits. *International Journal of Emerging Technology and Advanced Engineering, 4*(8), 541 - 546.

Vursavus, K. and Ozguven, F. (2004). Determination the Effects of Vibration and Packaging Method on Mechanical Damage in Golden Delicious Apples. *Turkish Journal of Agriculture and Forestry*, *28*(5), 311-320.

How to cite this article: Mayank, Singh Surender and Gurmeet (2023). Effect of Packaging Materials on Shelf-Life of Transported Aonla (*Emblica officinalis* Gaertn.) cv. Chakaiya. *Biological Forum – An International Journal, 15*(4): 83-87.