Response of Various Packaging Materials on Postharvest Quality And Life of Aonla Fruit (*Emblica Officinalis* Gaertn) Under Room Temperature

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Abstract

The present study entitled "Response of different packaging materials on postharvest life and quality of Aonla fruit (*Emblica officinalis* Gaertn) under room temperature" was carried out at Horticulture laboratory, School of Agriculture, Lovely Professional University, Punjab during the year 2017-18 and 2018-19. The good quality, healthy and fully mature fruits of Aonla cv. NA -10, free from injury and diseases were harvested. After sorting, the fruits were packed in (LDPE) 50 μ, (HDPE) 50 μ, (PP) 30 μ, shrink film 25 μ, cling film 15 μ, nylon bags, corrugated fiber box (CFB) butter paper bag, plastic box and stored at ambient conditions. Quality analysis of fruits was done after 5th, 10th and 15th day of storage. The experiment was conducted out in a CRD. Results revealed that the physiological loss in weight, shrinkage, rotting of fruits increased with the storage period. Postharvest treatment of LDPE (50μ) was recorded most effective in reducing fruit shrinkage and maintaining the quality during entire period of storage.

Keywords: Aonla, NA-10, quality, packaging.

Introduction

Aonla *(Emblica officinalis* Gaertn) is also known as Indian gooseberry and it belongs to family Euphorbiaceae(Parmar and Kaushal, 1982). Aonla fruit is rich in vitamin C. It contains ascorbic acid (300-900 mg / 100 g of pulp), amino acid and minerals along with phytochemicals like tannins, rutin, linoleic acid, phenols, antioxidants, corilagin and phyllemblin (Jain &Khurdiya, 2004; Murthy & Joshi, 2007; Ghorai&Sethi, 1996; Baliga& Dsouza, 2011). The fruit contains more vitamin C than guava, tomato and citrus (after the Barbados cherry) (Chauhan *et al.* 2005). A single fruit of Aonla have 20 times more vitamin C than the orange fruit and 3 times rich source of protein than the apple fruit (Goyal *et al.* 2007).Aonla is highly nutritive fruit due to its good medicinal values. Aonla fruits also exported under the unani herbs and ayurvedic type of medicine product at international trade. Fruits are also used as an indigenous medicine to cure many health problems like diabetes, colic, asthma, leprosy, headache, depression, dyspepsia, cough, flatulence, skin problems, bronchitis, scurvy, diarrhea, grayness of hairs and cancer (Jain *et al.* 2016).

Harvesting time of fruit is very short due to which market glut comes and producer sale their fruits at very low price. Aonla fruit is non-climacteric and perishable in nature, due to which it is very difficult to store it for long time at room temperature and to transport it to distant markets. About 20-30 % of fruits decays before they reach to the consumer due to the inadequate transportation facilities, harvesting methods, handling, storage conditions, packaging and market problems. Extension of shelf life and reduction of postharvest losses without deteriorating fruit quality is very important. Reduction of postharvest losses is achieved by controlling the processof respiration, transpiration and through the check of microbial infection. In India, various types of packaging materials are used for storage of Aonla fruits. Existing packaging material was gunny bags which results in more mechanical injury and economic loss to fruits. It has been reported that 17.2 per cent Aonla fruits has been lossed due to poor handling and packaging during transportation (Singh and Pathak, 1986). Wooden crates are mainly used for fruit transportation. Without any cushioning material in crates bruising takes place (Bruising is mechanical injury to fruits during harvesting and post harvesting when fruits are transported from one place to another place). Corrugated fiber boxes are more commonly used for storage and transportation with proper ventilation. CFB boxes are appropriate to storage due to proper ventilation, printable information on box, recyclable and less fruit spoilage. Maximum fruit spoilage takes place in gunny bags without any liner (30.19 %) and minimum loss takes place in CFB boxes (16%) (Singh *et al.* 2005). Polythene bags are more ideal for fruit storage for longer time at room temperature but are less economical.

Material and Methods

The experiment was undertaken during November-December 2017-2018 and 2018-19 at Horticulture laboratory of Lovely Professional University, Phagwara (Punjab). The good quality, healthy and fully mature fruits of Aonla cv. NA -10, free from injury and diseases were harvested during the first week of November. The experiment was carried out in Completely

Randomized design with 3 replications and 10 treatments*i.e*(LDPE, low density poly ethylene-50 μ), (high density poly ethylene, HDPE-50 μ), (poly propylene, PP 30 μ), shrink film 25 μ, cling film 15 μ, nylon bags, corrugated fibre box (CFB) butter paper, plastic box and control.
The wrapped and control fruits were kept at ambient conditions (11 to 20 ^{O}C and 58-62 % R.H) for storage. Physical parameters of fruits like physiological loss in weight (PLW), fruit rotting, and fruit shrinkage were noted at regular 5 days interval to find out the effect of various treatments on morphological parameters of Aonla fruits at the time of storage period.Physical parameters of fruits like fruit weight, physiological loss in weight (PLW), length: width ratio, fruit rotting, volume and shrinkage were noted at regular 5 days interval to record the effect of different treatments on morphological characters of Aonla fruits during storage.

Physiological loss in weight (PLW %): Weight of eight fruits was taken at regular intervals of storage with the help of weighing balance. Physiological loss in weight was calculated by using the following formula and data were expressed in percentage (%).

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

Rotting (%): Rotting of fruits was noted at regular intervals of storage. The following formula used to calculate the fruit decay.

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

Fruit shrinkage (%): Fruit shrinkage was recorded at regular intervals during storage. The following formula was used to calculate the per cent fruit shrinkage.

$$\text{Fruit shrinkage (\%)} = \frac{Intial\ \ fruit\ \ volume\ - final\ \ fruit\ \ volume}{Intail\ \ fruit\ \ volume} \times 100$$

Result and Discussion

Physiological loss in weight (%): In maintaining the freshness of the fruit, physiological loss in weight is an important parameter (Kumar *et al.* 2005). The data on effect of packaging treatments on physiological loss in weight is presented in Table 1. The physiological loss in weight (%) was increased with the increase in storage period. The minimum physiological loss of weight (1.37, 3.42 and 5.77 %) was recorded in the treatment of T_3 (Shrink 25 µ) on 5th, 10th and 15th day of storage respectively which was statistically at par with by treatment T_1 (LDPE 50 µ) and followed by T_7 (Cling 15 µ) during 2017-18. The maximum physiological loss in weight (5.16, 10.13 and 16.22 %) was recorded in treatment T_{10} (Control) on 5^{th}, 10^{th} and 15^{th} day of storage which was significantly followed by treatment T_4 (Nylon bag) and T_8 (Butter paper bag). During 2nd year 2018-19 similar trend was observed *i.e.* physiological loss in weight (%) increased with length of storage period irrespective of treatments. The minimum physiological loss in weight (1.57, 3.57 and 5.93 %) was recorded in treatment T_3 (Fruits packed in shrink 25 µ) on 5th, 10th and 15th day of storage respectively. Which was statistically at par with treatment T_1 (Shrink 25 µ) and followed by T_7 (Cling 15 µ), T_2 (HDPE 50 µ).The maximum physiological loss in weight (5.23, 10.31 and 17.21 %) was recorded in T_{10} (control) on 5th, 10th and 15th day of storage and followed by treatment T_4 (Nylon bag), T_8 (Butter paper bag) and T_6 (CFB box).

On the pooled mean basis minimum physiological loss in weight (1.47, 3.50 and 5.85 %) was recorded in treatment T_3 (Shrink 25 µ) on 5th, 10th and 15th DAS respectively, which was statistically at par with treatment T_1 (LDPE 50 µ) and followed by T_7 (Cling 15 µ) and T_2 (HDPE 50 µ). However, maximum physiological loss in weight (5.20, 10.22 and 16.71 %) was recorded in T_{10} (Control) on 5th, 10th and 15th DAS respectively, which was followed by T_4 (Nylon bag) and T_8 (Butter paper bag). The physiological loss in weight was increased gradually with storage period in all the treatments that might be due to higher transpiration and respiration rate of the fruit which leads to moisture loss (Jawandha, 2012). The fruits packed in shrink (25 µ) have minimum loss in weight than other treatments, which primarily due to the lower water vapour transpiration rate. The physiological loss in weight in film packed fruits is lower due restricted respiration process in the packaging films (Ben Yehoshua, 1985). In control, maximum weight loss was observed which might be due to direct exposure of fruits to the atmosphere and which led to the higher transpiration rate.

Fruit rotting (%): The effect of postharvest application of different packaging material on fruit rotting (%) of Aonla fruits cv. NA-10 during the year 2017 and 2018 is presented in Table 2. Fruit spoilage (%) was increased gradually with the progress of storage period. The higher fruit spoilage (12.32, 21.83 and 36.17 %) was noted in treatment T_9 (Fruits packed in plastic box) on 5th, 10th and 15th day of storage which was statistically at par with T_5 (PP 30 µ). Whereas lower fruit spoilage (6.84, 11.50 and 17.84 %) was noted in treatment T_3 (Shrink 25 µ) on 5th, 10th and 15th DAS which was significantly at par with treatment T_7 (Cling 15 µ). On 5th day of storage significantly lower spoilage (%) was observed in treatment T_{10} (control), T_6 (CFB box) and T_8 (Butter paper bag) as compare to T_2 (HDPE 50 µ) but on 10th and 15th day opposite results are recorded. During the 2nd year same trend was observed as in last year. A significant increase in fruit rotting was noted with the increase in storage period. The higher fruit spoilage (12.50, 21.23 and 34.83 %) was noted in treatment T_9 (Fruits packed in plastic box) on 5^{th}, 10^{th} and 15^{th} DAS which was statistically at par with treatment T_5 (PP 30 µ). Lower fruit spoilage (5.83, 10.28 and 18.00 %) was recorded in treatment T_3 (Shrink 25 µ) on 5^{th}, 10^{th} and 15^{th} DAS which was significantly at par with treatment T_7 (Cling 15 µ). On 5^{th} day of storage significantly lower spoilage (%) was observed in treatment T_{10} (control), T_6 (CFB box) and T_8 (Butter paper bag) as compare to T_2 (HDPE 50 µ) but on 10^{th} and 15^{th} day opposite results are recorded.

On the pooled mean basis minimum fruit rotting (7.60, 13.08 and 21.58 %) was recorded in treatment T_3 (fruits packed in shrink 50 µ) on 5^{th}, 10^{th} and 15^{th} DAS respectively, which was followed bytreatment T_7 (Cling 15 µ) and T_1 (LDPE 50 µ) .Whereas, maximum rotting (12.41, 21.53 and 34.94 %) was recorded in treatment T_9 (Plastic box) at 5^{th}, 10^{th} and 15^{th} DAS respectively, which was statistically at par with treatment T_5 (PP 30 µ).Fruit rotting (%) was increased with increase in storage period irrespective of treatments. In the packaging films due to the absence of ventilation, the heat produced during the respiration stayed in the packages which caused fruit spoilage during storage, irrespective of the packaging materials. In shrink (25 µ), the spoilage (%) was lower because the respiration rate and oxygen transmission rate was lower in it as compared to other films. Fruits packed in Nylon bag, CFB boxes, Butter paper bags and control had low incidence of fruit rotting as the transfer of heat produced due to respiration was possible. Whereas, in wrapped fruits this was not possible due to packing. Even then, shrink film maintained the favourable atmosphere in package which reduces the fruit respiration and maintain the textural properties of Aonla. These results are in align with the findings of Gupta and Mukherjee (1982) in Aonla fruits. Beera*et al.* (2012) reported the higher fruit rotting in polypropylene film due to absence of ventilation in Aonla. Positive role of shrink film in reducing spoilage loss was also reported by Partap*et al*. (2017) in sapota.

Fruit shrinkage (%): The effect of postharvest application of different packaging material on fruit shrinkage (%) of Aonla fruits cv. NA-10 during the year 2017-18 and 2018-19 is presented in Table 3. Fruit shrinkage (%) was increased gradually with the progress of storage period. A significant variation was observed in fruit shrinkage during storage period irrespective of treatments. The mean fruit shrinkage (8.50, 15.61 and 23.13 %) was recorded during 2017-18. The minimum fruit shrinkage (6.60, 12.05 and 19.00 %) was recorded in treatment T_1 (LDPE 50 µ) at 5^{th}, 10^{th} and 15^{th} DAS respectively, which was significantly followed by treatment T_3

(Shrink 25 µ) and T_7 (Cling 15 µ). However, the maximum fruit shrinkage (11.40, 19.77 and 28.70 %) was recorded in treatment T_{10} (control) on 5^{th}, 10^{th} and 15^{th} DAS respectively, which was significantly followed by T_4 (Nylon bag) and T_8 (Butter paper bag).

Similar trend in fruit shrinkage was observed in 2^{nd} year. A significant variation was observed in fruit shrinkage during storage period. The mean fruit shrinkage (7.41, 15.91 and 29.04 %) was recorded during 2018-19. The minimum fruit shrinkage (5.27, 12.76 and 20.45 %) was recorded in treatment T_1 (LDPE 50 µ) at 5^{th}, 10^{th} and 15^{th} DAS respectively, which was significantly followed by treatment T_3 (Shrink 25 µ) and T_7 (Cling 15 µ). However, the maximum fruit shrinkage (10.59, 19.40 and 29.05 %) was recorded in treatment T_{10} (control) on 5^{th}, 10^{th} and 15^{th} DAS which was significantly followed by treatment T_4 (Nylon bag) and T_8 (Butter paper bag).A significant variation was recorded in all treatments during storage. Fruit shrinkage was increased gradually with the increase in storage period. On the pooled mean basis the minimum fruit shrinkage (5.93, 12.40 and 19.72 %) was recorded in treatment T_1 (LDPE 50 µ) at 5^{th}, 10^{th} and 15^{th} DAS respectively, which was significantly followed by treatment T_3 (Shrink 25 µ) and T_7 (Cling 15 µ). However, the maximum fruit shrinkage (10.99, 19.58 and 28.87 %) was recorded in treatment T_{10} (control) on 5^{th}, 10^{th} and 15^{th} DAS which was significantly followed by T_4 (Nylon bag) and T_8 (Butter paper bag).

The fruit shrinkage (%) was increased continuously with increase of storage period irrespective of packaging materials. Increment in fruit shrinkage might be due to the reduction of fruit volume. Reduction of volume might be due to higher respiration and transpiration loss of fruits (Salisbury and Ross, 1992). Fruits packed in packaging films had less transpiration rate as compared to unwrapped fruits. The fruits packed in LDPE film had higher fruit volume than other treatments, which primarily be due to the low vapour transmission rate of LDPE and higher retention of moisture in fruit content (Beera, 2012).

Conclusion

From the above mention result and discussion, it can be concluded that packaging has significantly affected the postharvest quality and life of Aonla fruits. Among the various packaging materials, the fruits packed in LDPE films retained the excellent quality in all aspect and so it would be the most appropriate packaging material to minimize the losses and to store the fruits long days after harvest. Thus, LDPE (50 µ) is recommended to prolong the shelf life of freshly harvested Aonla fruits as well as in providing fresh fruits to the consumer.

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Table 1. Effect of postharvest packaging on physiological loss in weight (%) of Aonla cv. NA-10 during ambient storage conditions

		2017-18			2018-19			Pooled Mean		
Treatments		**5th**	**10th**	**15th**	**5th**	**10th**	**15th**	**5th**	**10th**	**15th**
T_1	**LDPE (50 µ)**	1.56	3.75	6.04	1.70	3.90	6.19	1.63	3.82	6.11
T_2	**HDPE (50 µ)**	2.00	4.45	7.28	2.00	4.64	8.25	2.00	4.54	7.77
T_3	**Shrink Film (25 µ)**	1.37	3.42	5.77	1.57	3.57	5.93	1.47	3.50	5.85
T_4	**Nylon Bag**	4.86	10.07	15.58	5.06	9.98	16.55	4.96	10.02	16.06
T_5	**PP Film (30 µ)**	2.20	5.10	8.04	2.18	5.05	7.42	2.19	5.07	7.73
T_6	**CFB**	2.69	6.21	9.54	2.71	6.26	8.82	2.70	6.23	9.18
T_7	**Cling Film (15 µ)**	1.92	4.23	6.89	1.96	4.32	8.05	1.94	4.28	7.47
T_8	**Butter paper**	3.14	9.22	14.32	2.84	9.11	14.74	2.99	9.16	14.53
T_9	**Plastic Box**	2.52	5.78	9.14	2.49	5.57	8.61	2.51	5.68	8.87
T_{10}	**Control**	5.16	10.13	16.22	5.23	10.31	17.21	5.20	10.22	16.71
Mean		2.74	6.24	9.88	2.78	6.27	10.18	2.76	6.25	10.03
C.D. at 5%		**0.71**	**0.78**	**0.50**	**0.91**	**1.01**	**0.59**	**0.81**	**0.61**	**0.48**

Table 2. Effect of postharvest packaging on fruit rotting (%) of Aonla cv. NA-10 during ambient storage conditions

		2017-18			2018-19			Pooled Mean		
Treatments		5th	10th	15th	5th	10th	15th	5th	10th	15th
T_1	LDPE (50 µ)	8.35	13.67	22.00	7.00	12.50	21.17	7.68	13.08	21.58
T_2	HDPE (50 µ)	10.31	17.50	25.33	10.07	17.67	25.00	10.19	17.58	25.17
T_3	Shrink Film (25 µ)	6.84	11.50	17.83	5.83	10.28	18.00	6.34	10.89	17.92
T_4	Nylon Bag	9.90	17.17	29.17	8.83	17.17	28.67	9.37	17.17	28.92
T_5	PP Film (30 µ)	12.02	21.50	33.18	11.17	20.33	33.23	11.60	20.92	33.20
T_6	CFB	9.77	16.87	25.83	9.17	16.40	24.53	9.47	16.63	25.18
T_7	Cling Film (15 µ)	7.60	12.35	20.50	6.00	11.67	19.17	6.80	12.01	19.83
T_8	Butter paper	10.15	18.00	28.17	9.20	17.83	28.00	9.67	17.92	28.08
T_9	Plastic Box	12.32	21.83	35.04	12.50	21.23	34.83	12.41	21.53	34.94
T_{10}	Control	9.64	18.33	29.83	8.23	18.07	30.50	8.94	18.20	30.17
Mean		9.69	16.87	26.68	8.80	16.32	26.30	9.25	16..59	26.49
C.D. at 5%		**1.58**	**2.44**	**2.12**	**2.02**	**2.64**	**2.47**	**1.25**	**1.61**	**1.74**

Table 3: Effect of postharvest packaging on fruit shrinkage (%) of Aonla Cv. NA-10 during ambient storage conditions.

		2017-18			2018-19			Pooled Mean		
Treatments		5th	10th	15th	5th	10th	15th	5th	10th	15th
T_1	LDPE (50 μ)	6.60	12.05	19.00	5.27	12.76	20.45	5.93	12.40	19.72
T_2	HDPE (50 μ)	7.95	14.47	21.35	5.92	13.96	22.66	6.94	14.22	22.01
T_3	Shrink Film (25 μ)	6.64	12.44	19.38	5.29	13.28	20.98	5.97	12.86	20.18
T_4	Nylon Bag	10.90	19.69	28.56	10.17	19.41	28.80	10.53	19.55	28.68
T_5	PP Film (30 μ)	8.03	14.60	21.53	6.95	15.47	22.76	7.49	15.04	22.14
T_6	CFB	9.14	15.68	22.87	8.16	17.08	24.43	8.65	16.38	23.65
T_7	Cling Film (15 μ)	6.71	13.03	20.35	5.89	12.99	21.59	6.30	13.01	20.97
T_8	Butter paper	9.59	19.48	27.61	8.17	19.48	27.20	8.88	19.48	27.41
T_9	Plastic Box	8.08	14.85	21.97	7.67	15.23	22.53	7.87	15.04	22.25
T_{10}	Control	11.40	19.77	28.70	10.59	19.40	29.05	10.99	19.58	28.87
Mean		8.50	15.61	23.13	7.41	15.91	29.04	7.96	15.76	23.59
C.D. at 5%		**0.39**	**0.35**	**0.26**	**0.28**	**0.28**	**0.37**	**0.31**	**0.21**	**0.16**