# Quality and Shelf-life of Sohshang (*Elaegnus latifolia* L.) Fruits in Different Packages during Storage

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## ABSTRACT

Sohshang (*Elaegnus latifolia* L.) is an important indigenous fruit of Meghalaya that grows in Khasi and Jaintia hills besides other places of North East India. It is being consumed to a great extent by the rural and tribal masses of the Northeast India for its unique taste. Sohshang fruits being highly perishable have a very short shelf life. The fruits get damaged during the process of handling, transportation and marketing due to non adoption of suitable post harvest management practices. Different packaging materials with and without perforation were used to extend the shelf life of the fruits at ambient condition. Packaging of fruits in non-perforated polypropylene extended the shelf life of fruits up to 9 days with better retention of almost all the quality characteristics of the fruits.

**Keywords**: Shoshang, fruits, packaging materials, storage, shelf life, quality

## INTRODUCTION

Sohshang (*Elaegnus latifolia* L.) is a large evergreen spreading type woody shrub that is mostly grown in semi-wild condition in the backyard garden throughout the North Eastern region of India. It is being consumed to a great extent by the rural and tribal masses of the Northeast India for their congenial taste. The fruits of Sohshang are highly perishable in nature and have a very short shelf life (1-2 days). Besides, due to lack of proper packaging materials, huge quantity of the fruits gets damaged during the process of handling, transportation and marketing. This situation has resulted in a glut in the local market causing huge losses to the farmers as they are compelled to dispose off their produce at throwaway prices. Packaging materials play a significant role in extending the shelf life of many fruits and vegetables. Besides, it helps in retention of ascorbic acid and such other antioxidants for a prolong period of time. Singh et al. (2008) reported that the shelf life of strawberry increased up to six days when they were packed in high-density polyethylene pouches. Likewise, the shelf life of passion fruits increased up to five weeks when the fruits were waxed and packed in polyethylene terephthalate packaging (Patel et al. 2009). Keeping these facts in view, a comprehensive study was carried out to identify a suitable packaging material to extend the shelf life of the sohshang fruits with desirable quality.

## MATERIALS AND METHODS

Fully ripe, undammaged Sohshang fruits of uniform size and maturity (pink colour) were collected from the experimental field of ICAR Research Complex for NEH Region, Umiam, Meghalaya. The healthy fruits were washed with chlorinated (100 ppm) water and the surface moisture was dried up at room condition under a fan. Thereafter, the fruits were packed in different packaging materials in five replications, viz., T0: unpacked and kept at room temperature (Control), T1: perforated polypropylene (PP, 100 gauge), T2: non-perforated polypropylene (100 gauge), T3:

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perforated low density polyethylene (LDPE, 200 gauge), T4: non-perforated low density polyethylene (200 gauge), T5: perforated LDHM (100 gauge), T6: non-perforated LDHM (100 gauge) with and without perforation (5 pinholes, 1mm in diameter) and T7: leaf (*Phrynium pubinerve* Bl.). Fruits kept inside the polybags as per treatments were sealed. Fruits packed with leaves (T7) were not sealed. The fruits so packed were stored at ambient condition for the study. The daily room temperature and relative humidity varied from 23.9 to 26.1°C and 27 to 43 % during the study period, respectively.

Ten fruits each for each of the treatments were kept for storage at ambient condition for recording the physiological loss in weight (PLW). Another 3 lots of 15 fruits each were kept for recording the other remaining parameters so that every bag could be opened at an interval of 3 days up to 10 days. PLW was determined at 3 days interval. Moisture was determined by oven dry method as described by Ranganna (1997). The decay loss (%) was recorded at a periodical interval and the cumulative decay loss was calculated using the standard formula as described by Ranganna (1997). The visual and textural qualities were determined as per the methodology suggested by Bhowmik and Pann (1992).

The textural property of the fruits in term of firmness was measured using a Stable Micro System TA-XT-plus texture analyzer (Texture Technologies Corp., UK) fitted with a 35 mm cylindrical aluminum probe. Firmness value was considered as mean peak compression force and expressed in kgf. The studies were conducted at a pre-test speed of 1 mm/sec, test speed of 2mm/sec, distance of 3.0 mm and load cell of 50 kg (Kudachikar et al. 2003).

The total soluble solids (TSS) content was determined with Erma Hand Refractometer (0-32 °B). Titratable acidity and fibre content were estimated as per AOAC (1980) and TSS: Acid ratio, total carotenoids were determined according to the methods described by Ranganna (1997). Ascorbic acid was determined by 2,6 di-chlorophenol-indophenol dye visual titration method of Freed (1966). Shelf life was determined based on visual and textural qualities of fruits by constituting a panel of five members.

## RESULTS AND DISCUSSION

The PLW increased with the increase in storage period irrespective of treatments (Table 1). Enclosure of fruits in plastic bags reduced the PLW as compared to fruits stored in open. However, the fruits packed in non-perforated PP recorded the lowest PLW (2.42 %) as compared to other packaging materials where the PLW varied from 2.89-18.94 % on the 9th day of storage. Similar findings were also reported in Kinnow mandarin (Thakur et al. 2002), Khasi mandarin (Singh et al. 2006), banana (Kudachikar et al. 2007) and loquat (Amoros et al. 2008).

Decay loss was found to increase with the advancement of storage period irrespective of packaging treatments (Table 1). On the 9th day of

**Table 1:** Effect of packaging materials on physiological loss of weight (PLW), texture and decay loss of Sohshang during storage

| Treatments | Days after storage | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | PLW (%) | | | Texture (kgf) | | | Decay (%) | | |
| | 3 | 6 | 9 | 3 | 6 | 9 | 3 | 6 | 9 |
| T0 (Control) | 16.58 | 35.72 | - | 0.770 | 0.719 | - | - | - | 6.63 |
| T1 (Perforated PP) | 1.02 | 2.15 | 3.49 | 1.472 | 1.407 | 1.181 | 12.41 | 13.01 | 33.18 |
| T2 (Non perforated PP) | 0.58 | 1.16 | 2.42 | 1.550 | 1.298 | 1.261 | - | - | 10.20 |
| T3 (Perforated LDPE) | 1.09 | 2.58 | 5.44 | 1.606 | 1.371 | 1.234 | 12.82 | 26.58 | 39.74 |
| T4 (Non perforated LDPE) | 0.99 | 1.98 | 3.68 | 1.487 | 1.340 | 1.165 | 18.13 | 26.59 | 33.28 |
| T5 (Perforated LDHM) | 1.11 | 3.87 | 5.08 | 1.479 | 1.259 | 1.207 | - | - | 39.88 |
| T6 (Non perforated LDHM) | 0.97 | 1.95 | 2.89 | 1.611 | 1.251 | 1.243 | 6.47 | 19.94 | 26.66 |
| T7 (Leaf) | 1.57 | 8.41 | 18.94 | 1.311 | 1.144 | 0.890 | - | 26.12 | 48.32 |
| $CD_{0.05}$ | 0.08 | 0.08 | 0.05 | 0.024 | NS | 0.017 | 0.10 | 0.08 | 0.08 |

storage, maximum decay loss (48.32 %) was observed in the fruits packed in leaf, while minimum loss (10.20 %) was recorded in the fruits packed in non-perforated PP. The result of the present study was in conformity with the reports of Kishan (1992) in ber and Jadhao et al. (2007) in Kagzi lime.

The study revealed a significant decline in texture of the fruits throughout the storage period. This was observed in all the packaging system (Table 1). At the end of storage period, fruits packed in non-perforated PP recorded the highest texture value (1.261 kgf) as compared to other types of packages (0.890-1.234 kgf). Preservation of freshness and firmness of the fruit might be affected by the modified environment created due to different types of packing. Similar observations were also reported by Perez et al. (1997) in strawberry and Amaros et al. (2008) in loquat.

In the present study, it was found that that the TSS contents of fruits increased throughout the storage period (Table 2). However, fruits under different packaging resulted in lower and slower accumulation of TSS (8.8-12.0 $^{o}$B) on the 9$^{th}$ day of storage with minimum change (8.8 $^{o}$B) in the fruits packed in perforated PP and non-perforated LDPE as compared to control, which recorded maximum TSS (14.5 $^{o}$B) on the 6th day of storage. The increase in TSS with the advancement of storage might be due to conversion of reserved starch and other polysaccharides to soluble form of sugars during storage (Singh and Narayan 1999). These findings were in conformity with that of Bhushan et al. (2002) in kiwifruit and Jadhao et al. (2007) in Kagzi lime.

The titratable acidity of fruits decreased with the progress of storage period (Table 2). Maximum decrease in acid content was observed in control (1.41 %) on the 6$^{th}$ day of storage as compared to a slower rate of decrease (1.92-1.41 %) in other treatments on the 9$^{th}$ day of storage with better retention of acidity (1.92%) in perforated PP, LDPE, non-perforated LDPE and leaf. Similar findings were also reported by Singh et al. (2006) in Khasi mandarin. The TSS: Acidity ratio was found to increase with increase in storage period irrespective of treatments (Table 2). A rapid increase in TSS: Acidity ratio from an initial of 2.34 to 10.29 was observed in fruits under control on the 6$^{th}$ day of storage as compared to a slower increase in other packaging materials (4.60-7.73) on the 9$^{th}$ day of storage with minimum TSS: Acidity ratio (4.60) in perforated PP and non perforated LDPE. The increase in TSS: Acidity ratio irrespective of storage time and treatments might be due to the increase in TSS and decrease in acidity during the same period. These findings were in conformity with those of Singh and Mondal (2006) in peach and Jadhao et al. (2007) in Kagzi lime.

The reducing sugar increased with the advancement of storage period irrespective of treatments (Table 3). Fruits without any treatment (control) exhibited a rapid increase in reducing sugars on the 6$^{th}$ day of storage as compared to fruits packed in non-perforated PP, which recorded a steadier increase in reducing sugars (2.98%) on the 9$^{th}$ day of storage. Similar results were also reported by Deka et al. (2007) in pineapple and Singh et al. (2007) in passion fruits.

**Table 2:** Effect of packaging materials on TSS, acidity and TSS: acidity ratio of Sohshang during storage

| Treatments | Days after storage | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | TSS ($^{o}$B) | | | Acidity (%) | | | TSS: acidity ratio | | |
| | 3 | 6 | 9 | 3 | 6 | 9 | 3 | 6 | 9 |
| T0 (Control) | 12.4 | 14.5 | - | 1.92 | 1.41 | - | 6.51 | 10.29 | - |
| T1 (Perforated PP) | 8.4 | 8.6 | 8.8 | 2.43 | 2.30 | 1.92 | 3.45 | 3.74 | 4.60 |
| T2 (Non perforated PP) | 8.1 | 9.3 | 10.9 | 2.43 | 1.66 | 1.41 | 3.33 | 5.64 | 7.73 |
| T3 (Perforated LDPE) | 9.4 | 9.6 | 10.0 | 2.30 | 2.30 | 1.92 | 4.16 | 4.18 | 5.24 |
| T4 (Non perforated LDPE) | 8.0 | 8.5 | 8.8 | 2.43 | 2.30 | 1.92 | 3.29 | 3.79 | 4.60 |
| T5 (Perforated LDHM) | 8.4 | 9.2 | 9.7 | 2.05 | 1.92 | 1.79 | 4.10 | 4.82 | 5.44 |
| T6 (Non perforated LDHM) | 9.0 | 9.4 | 9.9 | 2.30 | 1.92 | 1.66 | 3.91 | 4.90 | 5.98 |
| T7 (Leaf) | 8.0 | 10.3 | 12.0 | 2.30 | 2.18 | 1.92 | 3.48 | 4.76 | 6.23 |
| $CD_{0.05}$ | 0.39 | 0.35 | 0.30 | 0.30 | 0.35 | 0.49 | 0.65 | 0.79 | 0.57 |

**Table 3:** Effect of packaging materials on reducing sugar, ascorbic acid and total carotenoids of Sohshang during storage

| Treatments | Days after storage | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | Reducing sugar (%) | | | Ascorbic acid (mg/ 100g) | | | Total carotenoids (μg/g) | | |
| | 3 | 6 | 9 | 3 | 6 | 9 | 3 | 6 | 9 |
| T0 (Control) | 4.20 | 4.55 | - | 6.4 | 6.4 | - | 109.63 | 109.63 | - |
| T1 (Perforated PP) | 3.14 | 3.33 | 3.60 | 9.6 | 6.4 | 6.4 | 103.78 | 103.85 | 104.36 |
| T2 (Non perforated PP) | 2.78 | 2.96 | 2.98 | 9.6 | 9.6 | 9.6 | 69.70 | 70.22 | 70.41 |
| T3 (Perforated LDPE) | 3.14 | 3.33 | 3.85 | 9.6 | 8.0 | 8.0 | 97.99 | 98.96 | 99.02 |
| T4 (Non perforated LDPE) | 3.13 | 3.85 | 4.81 | 9.6 | 8.0 | 8.0 | 99.47 | 100.05 | 101.08 |
| T5 (Perforated LDHM) | 3.33 | 3.50 | 3.88 | 9.6 | 8.0 | 8.0 | 100.31 | 101.40 | 101.40 |
| T6 (Non perforated LDHM) | 3.08 | 3.57 | 3.60 | 8.0 | 6.4 | 6.4 | 74.85 | 75.23 | 75.49 |
| T7 (Leaf) | 2.80 | 3.07 | 3.70 | 9.6 | 8.0 | 8.0 | 80.70 | 81.47 | 81.53 |
| $CD_{0.05}$ | 0.05 | 0.08 | 0.05 | 0.17 | 0.24 | 0.12 | 0.30 | 0.11 | 0.30 |

Ascorbic acid content of the fruit declined during storage in all treatments (Table 3). However, fruits packed in non-perforated PP retained higher ascorbic acid content (9.6 mg/100g) as compared to other treatments (6.4-9.0 mg/100g) on the 9$^{th}$ day of storage. Reduction in ascorbic acid during storage was also reported by Mahajan et al. (2005) in Kinnow mandarin. The total carotenoids content of Sohshang increased significantly with the progress of storage period (Table 3). Maximum increase in total carotenoid content was observed in fruits under control (67.50-109.63 μg/g) on the 6$^{th}$ day of storage while the minimum increase was observed in fruits packed in non-perforated PP (70.41μg/g) on the 9$^{th}$ day of storage. This increase might be due to the degradation of chlorophyll and extensive accumulation of carotenoids as the chloroplasts were transformed to chromoplasts (Kader and Grierson 1978).

Shelf life of Sohshang fruits stored in different packaging materials was determined based on visual and textural properties of the fruits (Table 4). A gradual decrease in both visual and textural property of the fruits was observed with the increase in storage period. On 9th day of storage, the fruits packed in non-perforated PP recorded the highest visual (5.5) and textural (3.0) score while the fruits packed in leaf recorded the lowest visual (3.0) and textural (1.0) score (Table 4). The highest shelf life of 9 days was found in the fruits packed in non-perforated PP followed by non-perforated LDHM with 8 days of storage. However, the shortest shelf life was recorded in fruits without packaging, which had a shelf life of 3 days only. The extended shelf life with different packaging materials might be attributed to the modified environment created by accumulation of $CO_2$ and depletion of $O_2$ and maintenance of high humidity inside the pack. This

**Table 4:** Effect of packaging materials on visual and textural quality of Sohshang during storage

| Treatments | Days after storage | | | | | | Shelf life (Days) |
|---|---|---|---|---|---|---|---|
| | Visual quality | | | Textural quality | | | |
| | 3 | 6 | 9 | 3 | 6 | 9 | |
| T0 (Control) | 5.0 | 2.0 | - | 2.5 | 1.5 | - | 2-3 |
| T1 (Perforated PP) | 8.0 | 6.5 | 5.0 | 4.8 | 3.2 | 2.5 | 6-7 |
| T2 (Non perforated PP) | 8.0 | 7.5 | 5.5 | 4.8 | 3.5 | 3.0 | > 9 |
| T3 (Perforated LDPE) | 6.5 | 5.0 | 4.0 | 4.5 | 3.0 | 2.0 | 5-6 |
| T4 (Non perforated LDPE) | 6.8 | 6.0 | 5.0 | 4.5 | 3.2 | 2.5 | 6-7 |
| T5 (Perforated LDHM) | 8.0 | 7.0 | 5.0 | 4.5 | 3.3 | 2.5 | 6-7 |
| T6 (Non perforated LDHM) | 7.5 | 6.2 | 5.0 | 4.8 | 3.5 | 2.8 | 7-8 |
| T7 (Leaf) | 8.0 | 4.5 | 3.0 | 3.5 | 2.0 | 1.0 | > 4 |
| $CD_{0.05}$ | 0.24 | 0.30 | 0.24 | 0.24 | 0.39 | 0.17 | |

helped to maintain turgidity, higher firmness and freshness during storage (Emerald et al. 2001). The extended shelf life of the fruits in different packaging materials was also reported by Joshua and Sathimurthy (1993) in sapota, Bhushan et al. (2002) in kiwifruit, Kudachikar et al. (2007) in banana and Amoros et al. (2008) in loquat.

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