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Shelf Life Extensions of Pear cv. Nashpati using Shrink Wrapping in East Siang District of Arunachal Pradesh, India

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A B S T R A C T

Pear cv. Nashpati were subjected to three treatments viz. T_1 (Individual Shrink wrapping), T_2 (Shrink Wrapping in trays) and T_3(Control treatment) were stored in ambient condition (29-32^{o}C temperature and 55-78% relative humidity) in which periodical observations were recorded on physiological loss in weight (PLW, %), total soluble solid (TSS, °Brix), titratable acidity (mg of malic acid/g), decay loss (%) and sensory quality (%) at Department of Post-Harvest Management, College of Horticulture and Forestry, Arunachal Pradesh, India during the year 2017-2018. Result showed reduced rate of PLW (3.134%) and postharvest decay losses (30%) along with marketable quality of fruit having TSS (9.7^{o}Brix) and acidity (0.224%) in T_1 upto 20 days of storage as compared to other treatment. Hence, T_1 (Individual Shrink wrapping) was the most suitable packaging material for extending the shelf life of pear fruits upto 20-25 days at ambient condition with least PLW and maintaining the marketable fruit quality, which can be recommended for the pear grower for increasing the shelf life and better income generation in the near future of this region.

Introduction

Pear, a typical fruit of temperate climates, with delicate pleasant taste and smooth, has a wide acceptance throughout the world. It is mainly consumed *in natura*, pies, cakes, accompanying strong cheese, jams, and ice creams and is a great fruit to be consumed in diets because of its low caloric value. It has high nutritional value with reasonable amounts of vitamins A, B_1, B_2, B_3 and C and minerals like sodium, potassium, phosphorus, calcium, magnesium and iron. It has a lot of fiber, giving excellent results in the treatment of constipation and intestine inflammation. Many recommend pears to cure anomalies such as cystitis and kidney stones (Gonsalves, 2002). Ancient Greek poet Homer described Pears as one of the 'gifts of God'. This prehistoric fruit has been under cultivation both in Europe and Asia for long times (Hedrick *et al.*, 1921). Sand pear (Japanese and Chinese species) has been domesticated as edible fruit and cultivated in Asia for more than 3000 years (Lombard and Westwood, 1987). Advances in pear culture and varietal improvement were brought only in the 18th century. In Asia, China and Japan are the

leading pear growing countries where its cultivation remained in a semi-wild state for a long time (Kaur and Arya, 2012). In India, pear is next only to apple in importance, acreage, production and varietals diversity among temperate fruits in India. It is grown under temperate and subtropical conditions because of its wider climatic and soil adaptability. It is primarily grown in hills at 1,700-2,400 m above mean sea-level in the states of Himachal Pradesh, Jammu and Kashmir and Uttar Pradesh. Low-chilling pears have adapted very well in the subtropical regions (Chadha, 2001). In North East region of India, pear cv. Nashpati or Sandpear is grown mainly in Manipur, Meghalaya, Arunachal Pradesh, Sikkim and Nagaland. However, still now it is grown in the homestead garden or grown in the forest area as underutilized fruit crops. It is commonly known as Nashpati in this region and people like this fruit for fresh consumption.

However, due to high moisture content in the fruit it has short post-harvest shelf life resulting very short period availability in the market. Over the last 5-10 years, a change in attitude is noticed among the policy makers and general public with regard to quality and/or standard of life which ultimately demands quality as well as diverse source of food.

The Global Forum on Agriculture Research (GFAR) in 1999 also emphasized the role of underutilized species in raising income of the rural poor. These novel crops also will help these rural sectors in mitigating the malnutrition and hence enabling them a quality life (Swaminathan, 1999). Therefore, in the present study, an attempt has been made to evaluate the shelf life of pear cv. Nashpati by using individual and tray wrapping to extend the available period in East Siang district of Arunachal Pradesh, India.

Materials and Methods

Experimental site

The present investigation was undertaken in the College of Horticulture and Forestry, Central Agricultural University, Pasighat, Arunachal Pradesh, under the Department of Post-Harvest Management during the period from August to September 2017.

Raw materials

Freshly harvested, pear cv. locally known as Nashpati fruits free from blemishes obtained from Pasighat market, East Siang district of Arunachal Pradesh were used for the experiment. Precautions were taken while handling the produce to minimize abrasions and bruising which leads to accelerated spoilage and rotting.

Preparation of samples

Mature sand pear fruits of uniform size were washed with tap water to remove the dirt and then surface dried at room temperature by spreading it in blotting paper for 20-30 minutes.

The pears were then subjected to the following treatments viz.T_1-Individual wrapping with heat shrinkable film (15µ); T_2-Tray overwrapped with heat shrinkable film (15µ); T_3-No wrapping (open condition). The pears in heat shrinkable films were passed through a shrink wrapping machine (Chamber machine: 15X20) at 150ºC for 10-15 seconds. The pear fruits in different packages were stored in cool, dry place on racks at room temperature in the laboratory of the Department of Post-Harvest Management during the period from August to September, 2016. The average temperature and relative humidity during storage period varied from 29 to 32^{o}C and 55 to 78% respectively.

Observation

Physiological loss in weight (%)

Assam Lemon fruits were weighed initially and at 2 days intervals during storage. The results were expressed as

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

Total Soluble Solids

The total soluble solids (TSS) of the fruit juice were determined using a hand refractometer and expressed as per cent TSS after making the temperature correction at 20ºC.

Titratable acidity

The titratable acidity as percent citric acid of the Juice was determined, using the method described in AOAC (1995).

Decay (%)

Decay was recorded by visual observation of the numbered fruits at regular intervals by counting the number of decayed fruits.

Sensory quality

Sensory quality was recorded by visual observation of the numbered fruits at regular intervals for their general appearance and acceptability depending upon the condition of the fruits (Worawaran *et al.,* 2013). The assessment was carried out at the beginning of the experiment and on the 5th, 10th, 15th, 20th and 25th day of storage.

Marketability (%)

The number of fruits acceptable by consumer in each experimental lot on the day of observation was recorded and expressed in percentage (Assumi *et al.,* 2009).

Statistical analysis

The statistical analysis of various characters studied in this experiment was carried out as per the procedure appropriate to the design of experiment i.e. 2 factor factorial Completely Randomized Design by adopting the Statistical procedures given by Gomez and Gomez (1984).

Results and Discussion

PLW

A significant ($p<0.05$) difference in weight loss was observed among the packed and unpacked pears which increases with advancement of storage period. However, the lemons packed individually in heat shrinkable films show the lowest weight loss (4.075%) compared with the tray packed ones (5.619 %) on the 24th day of storage (Table 1). The PLW for the unpacked pears were as high as 13.480% on the 12th day of storage. The lower weight loss in T_1 might be due to increase in CO_2 concentration, low oxygen atmosphere and decrease in transpiration rate due to higher RH inside (Wang 1977; Gorini and Uncini 1981; Mercado *et al.,* 1995). Reduction in PLW or decay loss may primarily be due to creation of modified atmosphere around the fruits by the gas permeability properties of shrinkable films (Ben-Yehoshua, 2005; Ben-Yehoshua *et al., 1983).* Condensation of water droplets was observed in overwrapped trays.

TSS

The total soluble solids (TSS) of wrapped and unwrapped fruits were observed to increase during storage (Table 2). Lowest TSS (9.76^{o}Brix) was observed in T_1 [Individual wrapping with heat shrinkable film (15µ)] followed by T_2 [Tray overwrapped with heat shrinkable film (15µ)] with 9.96^{o}Brix on 25th day of storage and T_3 [No wrapping] with 12.00^{o} Brix on the 15th day of storage.

Table.1 PLW (%) of pears as affected by wrapping at different days of storage

Treatment	2	4	6	8	10	12	14	16	18	20	22	24
T_1	0.314	0.626	0.941	1.253	1.567	1.880	2.507	2.822	2.822	3.134	3.448	**4.075**
T_2	0.638	1.149	1.532	1.787	2.043	2.554	2.809	3.330	3.449	4.469	4.980	5.619
T_3	3.479	6.958	7.825	9.140	11.737	13.480	15.217	16.962	19.565	20.868	23.475	26.083
Mean	**1.47**	**2.91**	**3.43**	**4.06**	**5.11**	**5.97**	**6.84**	**7.70**	**8.61**	**9.49**	**10.63**	**11.92**
CD@5%	--	**0.003**	**0.006**	**0.012**	**0.008**	**0.012**	**0.002**	**0.014**	**0.007**	**0.003**	**0.012**	**0.005**
SEM±m	--	**0.001**	**0.002**	**0.003**	**0.002**	**0.003**	**0.001**	**0.003**	**0.002**	**0.001**	**0.004**	**0.001**

T_1-Individual wrapping with heat shrinkable film (15µ); T_2-Tray overwrapped with heat shrinkable film (15µ); T_3-No wrapping (open condition)

Table.2 TSS (^{o}Brix) of Pears as affected by wrapping at different days of storage

Treatment	0DAS	5DAS	10DAS	15DAS	20DAS	25DAS
T_1	**9.0**	**9.40**	**9.56**	**9.53**	**9.70**	**9.76**
T_2	**9.0**	**9.20**	**9.40**	**9.60**	**9.80**	**9.96**
T_3	**9.0**	**9.76**	**9.96**	**12.00**	**-**	**-**
Mean	**9.0**	**9.54**	**9.64**	**10.37**	**6.1**	**6.57**
CD@5%	-----	**0.17**	**0.14**	**0.17**	**0.16**	**0.09**
SEM±m	-----	**0.04**	**0.02**	**0.05**	**0.02**	**0.03**

T_1-Individual wrapping with heat shrinkable film (15µ); T_2-Tray overwrapped with heat shrinkable film (15µ); T_3-No wrapping (open condition)

Table.3 Titratable acidity (%) of pears as affected by wrapping at different days of storage

Treatment	0DAS	5DAS	10 DAS	15 DAS	20 DAS	25 DAS
T_1	0.448	0.362	0.352	0.224	0.224	**0.200**
T_2	0.448	0.352	0.320	0.288	0.214	0.192
T_3	0.448	0.382	0.187	0.193	--	--
Mean	**0.448**	**0.365**	**0.268**	**0.235**	**0.219**	**0.196**
CD@5%	**-**	**-**	**0.068**	**0.001**	**0.002**	**0.001**
SEM±m	**-**	**-**	**0.02**	**0.003**	**0.006**	**0,003**

T_1-Individual wrapping with heat shrinkable film (15µ); T_2-Tray overwrapped with heat shrinkable film (15µ); T_3-No wrapping (open condition)

Table.4 Decay (%) of pears as affected by wrapping during different days of storage in ambient condition

Treatment	0DAS	5DAS	10 DAS	15 DAS	20 DAS	25 DAS
T_1	0	0	0.000	21.667	30.000	**30.000**
T_2	0	0	5.333	23.333	48.333	48.333
T_3	0	0	21.667	53.333	--	--
Mean	**0**	**0**	**13.5**	**32.77**	**26.11**	**38.33**
CD@5%	**--**	**--**	**3.39**	**5.76**	**3.52**	**3.52**
SEM±m	**--**	**--**	**1.13**	**1.44**	**1.17**	**0.88**

T_1-Individual wrapping with heat shrinkable film (15µ); T_2-Tray overwrapped with heat shrinkable film (15µ); T_3-No wrapping (open condition)

Table.5 Sensory quality of lemon as affected by wrapping during different days of storage in ambient condition

Treatment	Days after Storage					
	0DAS	5DAS	10DAS	15DAS	20DAS	25DAS
T_1	5	5	5	5	4	4
T_2	5	5	4	4	4	3
T_3	5	4	3	2	1	1

Pear fruits were rated for visual quality, wilting and shriveling, using a scale of 1 to 5 in which 5=excellent, 4=good, 3=unacceptable, 2=poor and 1=very poor. Fruit appearance was rated "unacceptable" when the score was less than or equal 3.

Table.6 Marketability (%) of pears as affected by wrapping at different days of storage in ambient condition

Treatment	Days after Storage					
	0DAS	5DAS	10DAS	15DAS	20DAS	25DAS
T_1	100	100	100	96.67	86.67	76.67
T_2	100	100	100	76.67	66.67	53.33
T_3	100	79.67	56.67	44.67	--	--

T_1-Individual wrapping with heat shrinkable film (15µ); T_2-Tray overwrapped with heat shrinkable film (15µ); T_3-No wrapping (open condition)

The total soluble solids (TSS) of fruits stored in all the packaging materials were observed to increase during storage. Increase in TSS could be as a result of the breakdown of organic polymers into simple sugars as reported by Faseema *et al.*, (2011) and Mahajan and Singh (2014).

Titratable acidity

The titratable acidity of fruits decreases during storage irrespective of the packaging treatments (Table 3). T_1 has the highest acidity of 0.200% on the 25th day of storage followed by T_2 with 0.192%. Generally

organic acids usually decline during ripening of fruits as they are used as substrates for respiration or converted into sugars and their further utilization in the metabolic process of the fruits (Faseema *et al.*, 2011). In shrink wrapped fruits the lowering of acidity was delayed which might be due to the effect of shrink packaging film in delaying the respiratory and ripening process (Mahajan *et al.*, 2013).

Decay and sensory quality

Decay percentage was as low as 30.0% for T_1 and 48.33% for T_2 on 25th day of storage. However, T3 had a higher decay percentage of more than 50 even on the 15th day of storage (Table 4). T_1 had a good sensory score of 4 even on the 25th day of storage (Table 5). However T_2 and T_3 had a score of 3 and 1 on the 25th day of storage.

Marketability

Marketability of T_1 [Individual wrapping with heat shrinkable film (15µ)] was as high as 76.67 % on the 25th day of storage while T_2 [Tray overwrapped with heat shrinkable film (15µ)] with 53.33% on the 25th day of storage (Table 6). Marketability of T_3 [No wrapping] was as low as 44.67% on the 15th day of storage.

In summary, considering all the physical and quality parameters, it is concluded that T_1 (Individual Shrink wrapping) was the superior treatment because of high marketable fruits (76.67%), low physiological loss in weight (4.075%), TSS (9.76^{o}Brix), titratable acidity (0.20%) with better sensory score (4) with a shelf life of 20-25 days followed by followed by T_2 (Shrink Wrapping in trays) and T_3 (Control treatment) with 10-15days and 8-10days respectively. Therefore, that T_1 (Individual Shrink wrapping) can be recommended to the pear growers to increase the self-life under ambient condition and need to be further verified under adverse climatic conditions.

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