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# INFLUENCE OF LDPE PACKAGING ON POST HARVEST QUALITY OF MANGO FRUITS DURING LOW TEMPERATURE STORAGE

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**ABSTRACT**

The present studies were conducted to examine the effect of LDPE (Low density polyethylene) packaging on quality of Dashehari mango fruits under low temperature storage. Physiological mature fruits were subjected to LDPE packaging with different perforation levels (0, 0.05 and 0.1%) and were placed at 12±1°C for 4 weeks. The control fruits were packed in corrugated fiber board boxes. After four weeks of storage, minimum PLW (2.03 %) was registered in non-perforated LDPE packaged fruits while maximum PLW (9.86 %) was recorded in control fruits. This treatment also retained maximum fruits firmness (5.8 lbf) after three weeks of storage. However, maximum soluble solids content (17.20 %) were recorded in LDPE (0.1% perforation) packed fruits after 3 weeks of storage. At the end of storage, fruits kept in non-perforated LDPE packaging resulted in highest (0.41%) juice acidity while control fruits had lowest (0.18%) acidity. Similarly, control fruits developed maximum sensory quality rating of 8.5 till two weeks of storage and then showed declining trend. Maximum β-carotene content (3.32 mg/100g of pulp) was recorded in control fruits at 3rd week of storage. In conclusions, LDPE packaging (0.1 % perforation) of Dashehari mango fruits was effective in maintaining quality characteristics up to three weeks under low temperature storage.

## INTRODUCTION

Mango (*Mangifera indica* L.) is one of the most important and choicest fruit crop in India having a great cultural, socio-economic and religious significance since ancient times (Netravati *et al.,* 2015).Dashehari is leading cultivar of North India and its fruit is harvested during summer season when ambient temperature is high that rapidly deteriorates the quality of produce. Rapid ripening process of mango fruits after harvest is also responsible for shorter shelf life which is a major constriction for efficient handling and transportation (Jawandha *et al.,* 2013) as a result producer gets lower return. So there is need to prolong the storage life of mango fruits for prolonging the market availability. Modified atmosphere packaging (MAP) has been used to extend the shelf-life of fruits and is considered to be an effective method (Cliffe-Byrnes and O'Beirne, 2005). This technique employs the use of flexible plastic films with certain permeability to various gases and water vapour. In mango, LDPE packaging delayed ripening process, lowered loss in weight, maintained firmness and appearance during storage (Yahia, 2011). However, information is lacking on the effect of LDPE packaging on storage life and quality of 'Dashehari' mangoes under low temperature conditions. The purpose of study was to enhance the storage life of 'Dashehari' mango fruits using LDPE packaging materials under cold storage conditions.

## MATERIALS AND METHODS

The experiment was undertaken at Department of Fruit Science, Punjab Agricultural University, Ludhiana, India. Fruits of mango cv. 'Dashehari' uniform in size and free from any external defects were harvested for the storage studies. Fruits were harvested in the morning hours and immediately transported to Post Harvest Laboratory and subsequently fruits free from any external defects were sorted and desapped by clipping the pedicel. After desapping fruits were dipped in distilled water to remove any dirt and again washed with chlorinated water. Fruits were divided into four lots, three lots were weighed and packed into LDPE with no perforation, 0.05% perforated LDPE, 0.1% perforated LDPE. Fruits of the last lot (control) were weighed and packed into corrugated fibre board boxes. These packages were kept in the cold chamber at 12±1°C and 90-95%RH. Physio-chemical analysis of fruits was done at 0, 1, 2, 3and4 weeks ofstorage.PLW was recorded by subtracting final weight from initial weight of the fruits in the package and then expressed as percent weight loss with reference to the initial weight. Fruit firmness was recorded with help of stand mounted penetrometer (model FT-327, USA) fitted with 8 mm spherical tip. A small portion of fruit peel was removed and tip was inserted in fruit to record firmness from both the sides of fruit and expressed in lbf. A nine point hedonic scale was used estimating organoleptic quality on the basis of taste, appearance and flavor. For analysis of chemical parameters, mango pulp was squeezed and juice obtained was filtered through a cheese cloth. SSC was measured by using digital refractometer (*ATAGO, PAL-1*, model 3810, Japan) by placing juice on prism of the refractometer (Mazumdar and Majumdar, 2003). Titratable acidity was estimated by titrating juice of fruits against 0.1 N NaOH solution using phenolphthalein as an indicator (George and Murphy, 2010). β-carotene from fruit pulp was extracted by using acetone + petroleum ether (Rangana, 1986). Recorded data were analyzed for Analysis of Variance (Proc GLM) using statistical package SAS 9.3 (The SAS system for Windows, Version 9.3, SAS Institute, Cary, NC). Values of different parameters were expressed as the mean $\pm$ standard error using Fischer's LSD test ($p<0.05$).

## RESULTS AND DISCUSSION

### Physiological loss in weight

LDPE packaging was able to reduce physiological loss in weight of fruits during storage. However PLW of fruits increased during storage despite packed in LDPE or control (Fig.1a). During the entire storage period significant ($p<0.05$) lower PLW was observed in LDPE packed fruits as compared to control fruits. The maximum loss in weight was observed for control fruits, whereas, minimum was recorded in fruits packed in non perforated LDPE. In control fruits the rate of weight loss was highest from 2$^{nd}$ to 3$^{rd}$ week of storage, which may be due to onset of peak respiration associated with ripening. No significant differences ($p<0.05$) were observed amongst LDPE packed fruits, except in non perforated LDPE treatment after 2 weeks of storage which recorded minimum loss in weight. Lower physiological loss in weight of LDPE packaged mangoes could be due to a slow rate of ripening and prevention of excessive moisture losses. Minimum weight loss in non-perforated polythene packed fruits could be due to lesser availability of oxygen for respiration, which retarded the rate of respiration and thereby lowering the moisture loss due to transpiration (Nath *et al.,* 2012).Similar findings were reported by Singh *et al.* (2013a) who found that LDPE packaging reduced PLW in mango fruits.

### Firmness

Fruit firmness is one of the main indices in judging the quality of mango fruits for table consumption. In our study the firmness of fruits declined with progressive increase in storage period irrespective of treatment given to fruits (Fig.1b). Softening of mango fruits with ripening is because of activity of endo-polyglacturonase (Razzaq *et al.,* 2013) and glucanases (Ali *et al.,* 2004). Mango fruits packed in non perforated LDPE film maintained a significantly highest firmness during entire storage period. Minimum firmness was recorded in control fruits. After one week of storage fruit firmness showed significance difference between all LDPE packaging treatments and control. However after 2 weeks of storage, firmness of 0.1% perforated LDPE and control fruits was at par. Similarly, after 3 weeks of storage, significant higher fruit firmness was recorded only in non perforated LDPE packed fruits. Results are similar to findings of Gonzalez *et al.* (1990) who reported that low film permeability in MAP conditions decreased fruit softening in 'Keitt' mangoes.

### Soluble solids content

Effect of packing on soluble solids content is summarized in Fig. 1c. SSC was recorded minimum in non perforated LDPE packed mango fruits throughout the storage period. Soluble solids content of LDPE packed fruits displayed an increasing trend upto 3 weeks of storage and then declined, whereas for control fruits soluble content increased upto 2 weeks of storage and subsequently declined till end of storage. The increase in TSS with the advancement of storage period might be due to conversion of reserved starch and other polysaccharides into soluble form of sugar (Gohlani and Bisen, 2012). Maximum SSC was recorded in control fruits after 1, 2 and 4 weeks of storage. These results arealso in line with the findings of Yamashita *et al.* (2002) who reported high SSC in control fruits of atemoyas may be due to accelerated ripening in non-wrapped fruits because of their higher respiration rates. Hence fruits packed in non perforated LDPE may have recorded lower soluble solids as compared to fruits which were kept in environment with greater respiration.

### Titratable acidity

Changes in juice titratable acidity of fruits in response to LDPE packaging during cold storage is summarized in Fig.1d. It showed declining trend with increment in storage intervals in all the LDPE packaging treatments or control. The decline in acidity was sharp upto one week and then slowed down up to end of storage. This decrease in acidity could be ascribed to the utilization of organic acids as respiratory substrate during storage as reported by Echeverria and Valich, (1989) and by conversion of acids into sugars. At the end of storage, the acid content for 0.05%, 0.1% perforated LDPE packed and control fruits was about 10 times lesser than at the harvest time. However, for non perforated LDPE packed fruits it was about 5 times lesser than at harvest period and this treatment recorded significantly highest acid content throughout the storage period. The minimum juice acidity was recorded in control fruits and it was at par with 0.05% and 0.1% perforated LDPE packed fruits. Similar results were reported by Singh *et al.* (2013b)in mango.

### Sensory rating

The results pertaining to effect of LDPE packaging on organoleptic properties of fruits during cold storage are presented in Fig.1e.At the time of harvesting and after one week of storage the fruits were hard in texture and hence posses poor edible qualities. After two weeks, control fruits were assigned very much desirable sensory quality in taste panel which was significantly higher than all other packaging treatments, but afterwards the control fruits continue decrease in sensory quality up to end of storage. In 0.1% perforated LDPE packed fruits maximum acceptability was attained in fruits packed after three weeks of storage, it continued to 4$^{th}$ week and this treatment was closely followed by 0.05% perforated LDPE packaging treatment. Fruits packed in non perforated LDPE had lowest sensory score throughout the storage period. This may be due to poor gaseous exchange in fruits kept in non perforated packaging and fruits remain too hard which eventually developed poor taste. Ladaniya (2007) reported that modified atmosphere packaging resulted in significantly higher flavour and appearance score in "Nagpur" mandarin fruits.

### β-Carotene

Effect of LDPE packaging on β-carotene content of mangoes is summarized in Fig.1f.During ripening of fruits disappearance of chlorophyll is normally associated with unmasking of carotenoids and the fruit acquiring bright yellow-red colour.

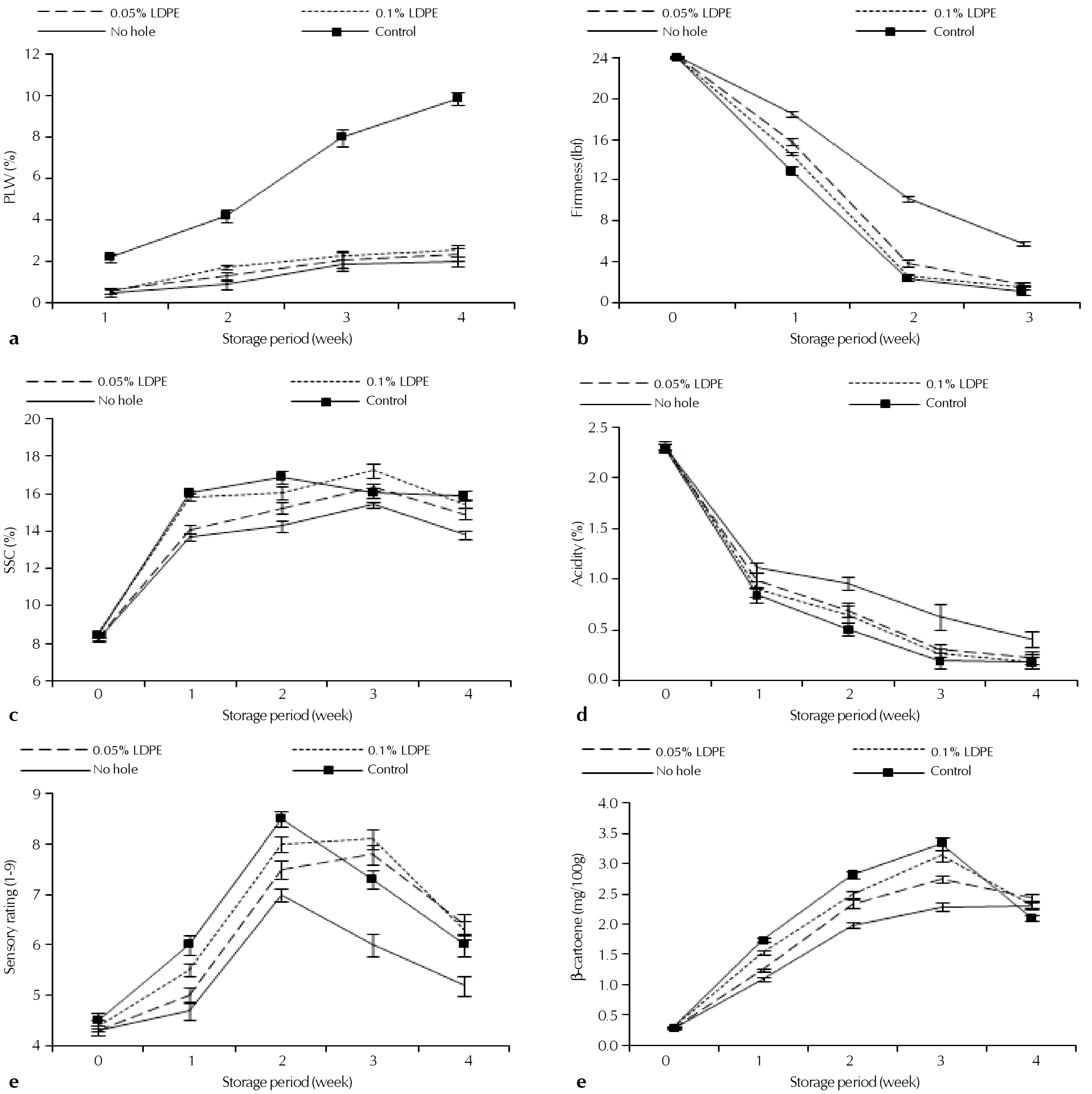


**Figure 1: Changes in PLW (a) fruit firmness (b), SSC (c), juice acidity (d), sensory rating (e) and β-carotene (f) of mango fruitsduring cold storage. Vertical bar represents ± SE of mean**

β-carotene content of fruit pulp showed an increasing trend up to 3rd week of storage, thereafter it declined irrespective of treatments. Similarly, Gonzalez *et al.* (2008) also reported an initial increase in β-carotene concentrations, followed by gradual reduction of the vitamin concentration in Kent and Keitt cultivars of mango. After 3 weeks of storage, maximum β-carotene content was recorded in control fruits and the minimum content was recorded in LDPE packed fruits with no perforation. At 4 weeks of storage, maximum loss of β-carotene content was displayed by control fruits. Significant difference in β-carotene content was observed between non- perforated LDPE packed fruits and control fruits throughout the storage period. Mango ripening produces an increase in β-carotene content, which is more significant at room temperature, and may be due to an increase in mevalonic acid and geraniol syntheses, which lead to higher levels of total carotenes (Mitra and Baldwin, 1997). LDPE packaging delay ripening process and hence carotenoid contents increased gradually during storage. LDPE packaging delayed ripening and carotenoids synthesis during ripening (Ali *et al.*, 2015).

From present study, it can be concluded that LDPE packaging (0.1% perforation) helped in reduction of PLW and effectively retained internal quality characteristics of 'Dashehari' mango fruits up to three weeks of storage.

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