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International Journal of Current Research
Vol. 8, Issue, 12, pp.44183-44188, December, 2016

INTERNATIONAL JOURNAL OF CURRENT RESEARCH

ISSN: 0975-833X

RESEARCH ARTICLE

EFFECT OF POST HARVEST APPLICATION OF DIFFERENT PACKAGING MATERIALS AND STORAGE INTERVALS ON SHELF LIFE OF PEAR CV. PUNJAB BEAUTY

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ARTICLE INFO

Article History:
Received 08th September, 2016
Received in revised form
16th October, 2016
Accepted 26th November, 2016
Published online 30th December, 2016

Key words:
Pear Fruits,
Pyrus Communis, Cold Storage,
TSS, CFB,
Wooden Boxes,
Sugars.

ABSTRACT

The present investigation was carried out in the laboratory of Department of Horticulture Khalsa College, Amritsar during the year 2015-16. The fruits of semi-soft pear(*Pyrus communis)* cv. Punjab Beauty were harvested from the healthy trees at physiologically mature stage in the last week of July from a well maintained Govt. Orchard and Nursery, Attari Distt, Amritsar and were packed in CFB and wooden boxes and kept under cold storage at 0° to 3.3°C and 90% relative humidity. The fruits from each treatment were analysed for physico-chemical characteristics after 0, 20, 40 and 60 days of cold storage period. The results revealed that the fruits packed in CFB boxes reduced the PLW, spoilage loss and increased firmness upto 60 days of storage with maximum edible quality.TSS and sugars were maximum in fruits packed in wooden boxes.

Citation: Ravinder Singh and Amarjeet Kaur, 2016. "Effect of post harvest application of different packaging materials and storage intervals on shelf life of pear cv. Punjab beauty", *International Journal of Current Research*, 8, (12), 44183-44188.

INTRODUCTION

Pear (*Pyrus communis* L.) belongs to family Rosaceae and is an important fruit cultivated throughout the temperate regions of the world (Anonymous, 2005). It is undoubtedly one of the most ubiquitous of all the fruits and ranks 2nd next only to apple in the deciduous fruits of the world (Chadha, 2001). The Greek poet 'Homer' giving an insight on early fruit culture praised "pears as one of the gift of God" (Ayn, 2014). The cultivars of pear mainly belongs to three groups, European, Asian and their hybrids. Two major species, *Pyrus communis* L. (European pear) and *Pyrus pyrifolia* (Burm) Nakai are commercially cultivated. Although pear is a temperate fruit, but it is less winter hardy due to which it can be grown in a wide range of climatic conditions, even in the warmer climates of subtropical regions. It is successfully grown in both the temperate and subtropical conditions, because of its low chilling requirements. The pear germplasm has been found to be suitable under sub-tropical conditions (Sandhu *et al.,* 2007). Pear fruit is packed with health beneficial nutrients such as dietary fiber, anti-oxidants, minerals and vitamins which are necessary for optimum health. It is also a good source of vitamin C and folic acid (Brian and Cameron, 1995).

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The fiber in pear is peptin which is a solute fiber that helps to control blood cholesterol level and cellulose is an insoluble fiber that promotes normal bowel function. It is also a rich source of proteins needed by both children and adults if properly processed and blended (Okaka *et al* 2002). Semi-soft pear cv. Punjab Beauty has gained popularity because of its superior organoleptic qualities. This cultivar matures in the third week of July, when the temperature and humidity are very high, which interferes with the shelf life of fruits in the market. The loss of great magnum at this time not only robs the labour and resources but also cuts short a profit. In order to prevent the glut in market, storage of fruits is necessary (Kaur *et al* 2013). Further, the storage of fruits in proper packaging materials helps in curtailing the post-harvest losses and preserves freshness (Ding *et al* 2002; Yadav *et al* 2005; Kudachikar *et al* 2007). Hence, there is a need to study the combined effect of storage intervals and packaging materials in pear for maintenance of its quality during storage till it reaches to the consumer. Keeping these viewpoints in view, this study was taken into consideration.

MATERIALS AND METHODS

The present study was carried out in the laboratory of Department of Horticulture, Khalsa College, Amritsar during 2015-16. The fruits were harvested from healthy trees of a well maintained Govt. orchard and Nursery, Attari, Distt. Amritsar.

The orchard is located 25 km away from Amritsar in West and falls at 31° - 38' N latitude and 74°-52' East longitude with an elevation of 236 m above MSL. The fruits of semi-soft pear(*Pyrus communis)* cv. Punjab Beauty were harvested from the healthy trees at physiologically mature stage in the last week of July from a well maintained Govt. Orchard and Nursery, Attari Distt, Amritsar and were packed in CFB and wooden boxes and kept under cold storage at 0° to 3.3°C and 90% relative humidity. The fruits from each treatment were analysed for physico-chemical characteristics after 0, 20, 40 and 60 days of cold storage period. The physiological loss in weight (PLW) was calculated on initial basis. The spoilage percentage of fruits was calculated on number basis, by counting the fruits from each box that had spoiled during each storage interval and expressed in percentage. The firmness was measured with the help of "Fruit tester" Penetrometer made in Italy by after removing about one square inch of skin of the fruit from the shoulder end. The reading was recorded in kg/cm^2. The Total soluble solids of fruits sample were determined with the help of a Erma hand refractrometer. The titratable Acidity was calculated and expressed in terms of malic acid determined by titrating a known volume of juice with 0.1 N NaOH using phenolphthalein as an indicator. The sugars were determined by the method of (AOAC 2000).The data was analyzed statistically as Randomised block design with factorial arrangement having three replications, each replication comprising of 2 kg fruits.

RESULTS AND DISCUSSION

The loss in weight also increased significantly with the increasing period of storage. Minimum PLW (2.09%) was recorded after 20 days of cold storage while maximum PLW (7.38%) was recorded after 60 days of cold storage. The fruits packed in CFB boxes showed significantly lower PLW (3.14%) than fruits packed in wooden boxes showing PLW (3.45%).The percentage loss in weight of fruits packed in CFB boxes was less due to the build up of higher humidity condition inside the boxes resulting in lesser loss of net weight of fruits. Also, the retardation of enzymatic activity of post harvest pathogens might lead to lesser loss in weight. Wooden boxes showed maximum loss due to moisture absorption by the timber from the fruits and subsequent loss of this moisture to the atmosphere lead to shriveling of skin surface by high rate of dehydration (Kaur *et al* 2013). However, CFB boxes provided better barrier to water absorption (Kaushal *et al* 1996 and Kahlon 2007) observed minimum loss in weight of fruits of peach in CFB boxes whereas it was maximum in wooden boxes. Increase in PLW with prolongation of storage period might be due to the loss of water from fruits after harvest by transpiration and respiration triggered by physiological metabolic or enzymatic activities. Similar trends of PLW was noticed by Sandhu and Singh(2000), Mohla (2001) in Patharnakh pear, Bajaj (2004) in Baggugosha pear and Singh (2005) in ber fruits cv. Umran, Kaur (2006) in Punjab Nectar and Kaur *et al* 2013 in Punjab Beauty pear. The data on storage days revealed that upto 20 days of cold storage there was no spoilage (0.00%) noticed in the fruits. The spoilage increased significantly with the advancement of storage period. The maximum spoilage (12.57%) was recorded after 60 days of storage. The increase in the spoilage losses with the duration of storage period might be attributed to the fact that ripening, ageing, fungal infection and biochemical changes in post harvest fruits lead to softening, spoilage and deterioration of the fruits.

The hydrolysis of metabolites in the stored fruits with the time was also a reason for spoilage. The results are advocated by the findings of Singh (1997) in Baggugosha pear, Chug (2001) in Patharnakh pear, Kaur (2001) and Bajaj (2004) in Baggugosha pear, Kaur (2006) in pear cv. Punjab Nectar, Ayn *et al* (2014) in Bartlett pear. It is evident from the data that the fruits packed in CFB boxes after treatments showed significantly lower mean spoilage (4.59%) than the fruits packed in wooden boxes which resulted in higher spoilage (4.94%).Different treatments were found effective in minimizing spoilage losses of pear fruits under CFB than wooden boxes. Similar results were presented by Kaur (2006) in Punjab Nectar pear. The packaging material of CFB boxes proved successful than wooden boxes in recording significantly less spoilage of fruits. This might be due to lesser bruising and proper ventilation in CFB boxes. The fruits got spoiled because of the increased respiration rate leading to softening and ripening of fruits. The research findings of Kahlon (2007) in peach cv. Shan-i-Punjab and Kaur *et al* (2013) in pear cv. Punjab Beauty are in conformation with the present results.

The firmness showed a linear decline with the increase in storage intervals. Maximum firmness (10.94 kg/cm^2) was recorded at day of harvest or zero day in CFB and wooden boxes respectively. Minimum firmness (7.55 kg/cm^2 and 7.37 kg/cm^2) was recorded after 60 days of cold storage in CFB and wooden boxes respectively. All the periods or days of storage exhibited significant firmness. It was observed that with the advancement of storage period the firmness decreased which might be due to the increased rate of senescence stage, which promoted respiration, transpiration and other microbial activities which reduced the firmness of fruits. The results are in agreement with Kaur (2013) in pear cv. Punjab Beauty and Ayn *et al* (2014) in Bartlett pear who also reported a decrease in fruit firmness with advancement in storage period.The fruits packed in CFB boxes had significantly higher firmness (9.70 kg/cm^2) than fruits packed in wooden boxes which resulted in lower firmness (9.59 kg/cm^2).Fruits packed in CFB exhibited higher fruit firmness than the fruits packed in wooden boxes which may be ascribed to the increased metabolic activities of the fruits in wooden containers resulting in breakdown of insoluble protopectin to soluble pectin and pectic acid by the activity of endopolygalacturonase enzyme in fruits.(Martin-Cabrejas *et al* 1994).These are in line with findings of Kaushal and Anand (1986) in apple fruits, Kaur *et al* (2013) in pear cv. Punjab Beauty, Gill *et al* (2016) in pear cv. Punjab Beauty.

It is evident from the data that the score of fruit colour decreased with increased storage period. Excellent fruit colour (8.74) was recorded on day of harvest irrespective of packaging respectively. The colour of fruits exhibited downward trend, with the storage period due to cell wall changes. Improvement in fruit colour might be due to degradation of chlorophyll of the fruits and increased synthesis of carotenoids and anthocyanin pigments. These results coincides with the findings of Monika (2003) and Bajaj (2004) in Baggugosha pear fruits.The minimum score of fruit colour (6.47) and (6.93) has observed in wooden and CFB boxes after 60 days of cold storage respectively. The fruits packed in CFB boxes showed superiority in colour (8.04) than the fruits packed in wooden boxes (7.78) respectively. These differences were significant. The above results coincides with the findings of Monika (2003) and Bajaj (2004) in Baggugosha pear fruits.
The total soluble solids (TSS) increased during storage upto 40 days and slightly declined thereafter.

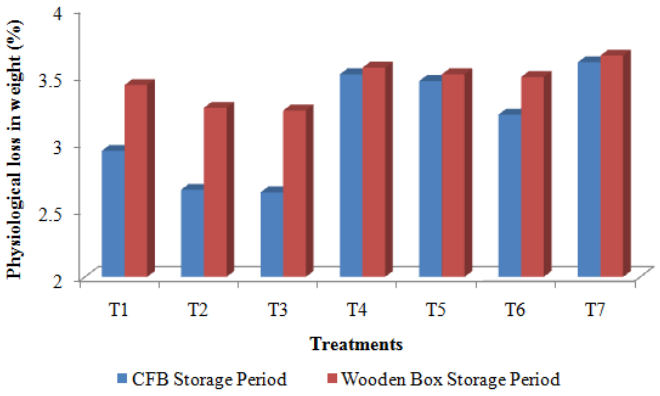

Fig. 1(a): Effect of different treatments on physiological loss in weight (%) of pear cv. Punjab Beauty during cold storage

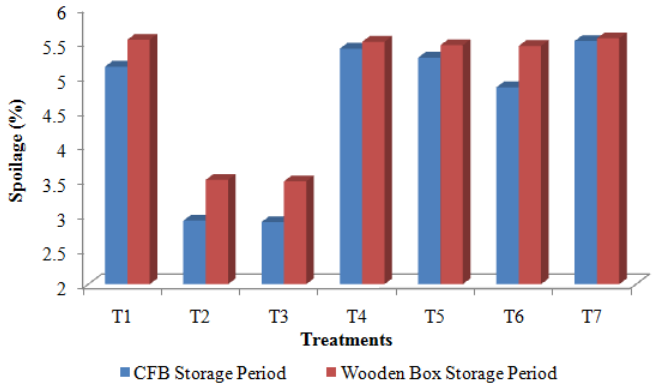

Fig. 2(a): Effect of different treatments on spoilage (%) of pear cv. Punjab Beauty during cold storage

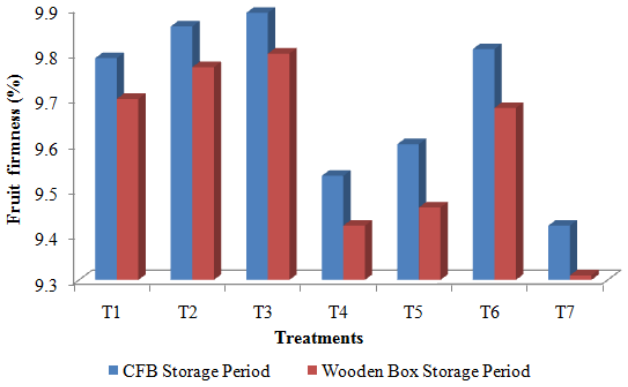

Fig. 3(a): Effect of different treatments on fruit firmness (%) of pear cv. Punjab Beauty during cold storage

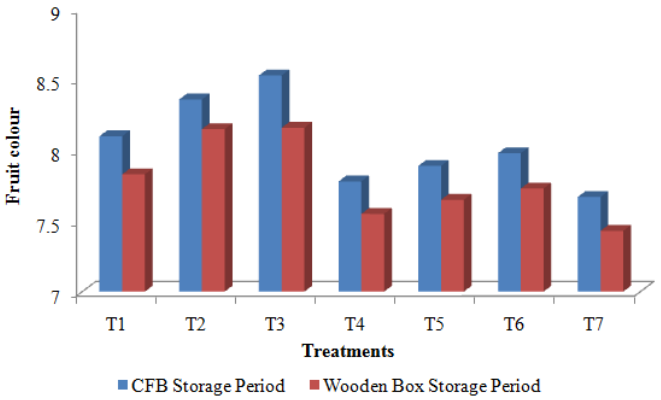

Fig. 4(a): Effect of different treatments on fruit colour of pear cv. Punjab Beauty during cold storage

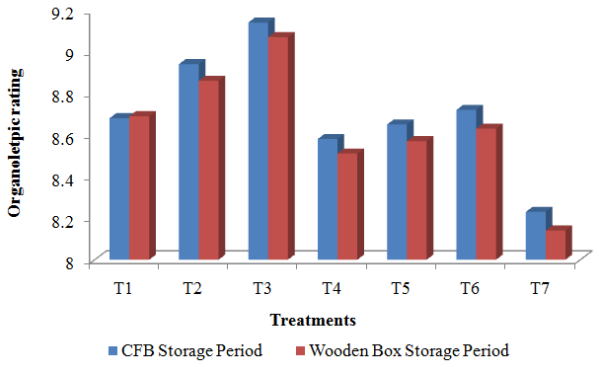

Fig. 5(a): Effect of different treatments on organoletpic rating of pear cv. Punjab Beauty during cold storage

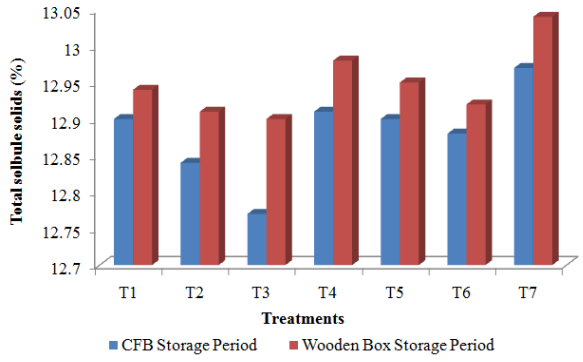

Fig. 6(a): Effect of different treatments on total soluble solids (%) of pear cv. Punjab Beauty during cold storage

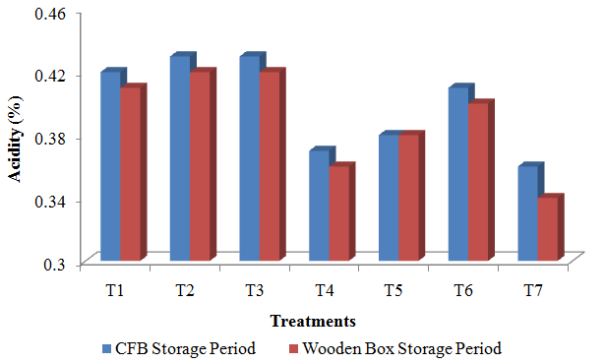

Fig. 7(a): Effect of different treatments on acidity (%) of pear cv. Punjab Beauty during cold storage

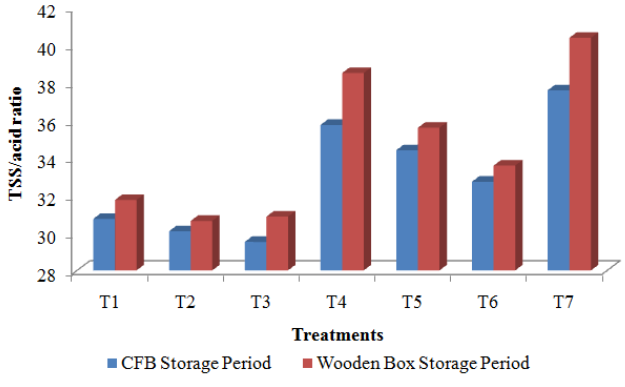

Fig. 8(a): Effect of different treatments on TSS/acid ratio of pear cv. Punjab Beauty during cold storage

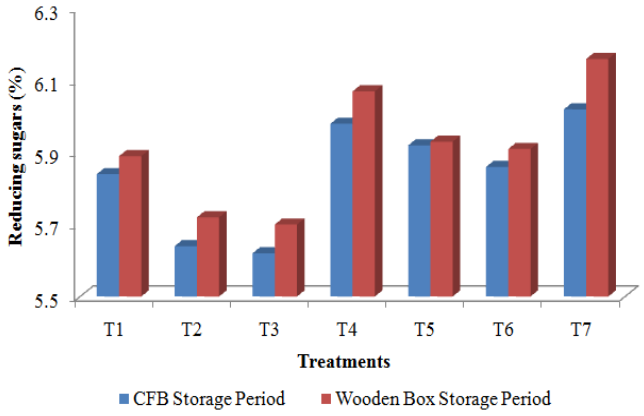

Fig. 9(a): Effect of different treatments on reducing sugars (%) of pear cv. Punjab Beauty during cold storage

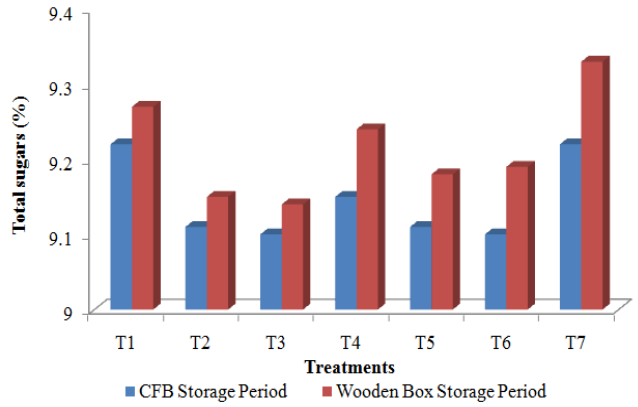

Fig. 10(a): Effect of different treatments on total sugars (%) of pear cv. Punjab Beauty during cold storage

The mean TSS content (13.80%) after 40 days was significantly higher as compared to all other storage intervals under wooden boxes and (13.74%) in CFB. Minimum TSS content (12.48%) was recorded on the day of harvest before storage of fruits respectively. The increase in TSS content during storage might be due to the moisture loss, hydrolysis of polysaccharides and concentration of juice as a result of degradation. The TSS increased upto 40 days and declined thereafter which can be attributed to the fact that on complete hydrolysis of starch no further increase in TSS occur and consequently a decline in TSS is predictable as they are the primary substrate for respiration (Wills *et al.,* 1980), Mahajan and Dhatt (2004). These results are in agreement with those of Paul (2002), Monika (2003), Singh (2004) and Bajaj (2004) in Baggugosha pear fruit, Kaur *et al.* (2013) in Punjab Beauty and Kaur (2006) in Punjab Nectar fruits. The data revealed that the fruits packed in CFB boxes registered lower TSS (12.86%) and fruits packed in wooden boxes registered higher TSS (12.95%) which differed significantly from each other. The higher TSS content in fruits packed in wooden boxes in comparison to CFB boxes may be ascribed to the increased metabolic activities, increase in PLW and hydrolysis of starch. These findings are in accordance with Kaur *et al.* (2013) in Punjab Beauty pear fruits, Thakur and Lal (1989), Kahlon (2007) who reported higher TSS in wooden boxes than in CFB boxes.

There was a progressive decrease in acidity with the increase in storage period upto 40 days and thereafter increase in acidity upto 60 days. Higher mean acidity (0.46%) was recorded on day of harvest irrespective of packaging. Minimum mean acidity (0.36% and 0.34%) was noticed after 40 days in CFB and wooden boxes respectively. Such a decrease in the acidity level could be attributed to the use of organic acids as respiratory substrate during storage (Echeverria and Valich 1989) and by conversion of acids to sugars and their utilization in metabolic activities of fruits as reported by Kahlon and Sandhu. (1989) in Patharnakh, Mahajan and Dhatt (2004) in Asian pear, Kaur (2001) in Baggugosha pear, Monika (2003) and Bajaj (2004) in Baggugosha pear, Sidhu *et al.* (2009) in Punjab Beauty are also in agreement with this study. The fruits packed in CFB boxes and wooden boxes have non-significant difference (0.40% and 0.39%) in CFB and wooden boxes.

It is quite obvious from the data that TSS: acid ratio increased progressively upto 40 days and than declined upto 60 days. Minimum TSS: acid ratio (27.28) was observed on the day of harvest. However maximum TSS: acid ratio (38.7) and (42.01) was recorded after 40 days in CFB and wooden boxes respectively.With the advancement in storage period TSS: acid ratio also increased. This might be due to the increase in total soluble solids and reduction in acidity of fruits with increase in storage period. The balance between TSS and acidity decides the overall acceptability of fruits. During storage many biochemical changes might took place which distributed the TSS: acid ratio. The continuous decrease in acidity and concomitant increase in TSS content resulted in increase in TSS: acid ratio. These results of present studies are in accordance with earlier findings of Hussain *et al.* (2001) in apple and Kaur *et al*. (2013) in pear cv. Punjab Beauty. From the data it is evident that fruits packed in CFB boxes after treatment recorded lower TSS: acid ratio (32.98) whereas fruits packed in wooden boxes recorded higher TSS: acid ratio (34.48).The TSS: acid ratio was significantly higher in fruits packed in wooden boxes than CFB boxes. This might be due to more moisture loss from the fruits in wooden boxes leading to more concentration of juice resulting in higher sugar content whereas maximum decrease in acidity of fruits packed in wooden boxes might be due to increased respiration rate and more utilization of acids in bio-chemical activities leading to the depletion of organic acids. These results are corrugated with the findings of Kore and Sharma (1970) in ber fruits, Kaur *et al.* (2013) in pear fruits cv. Punjab Beauty. The reducing sugars increased with storage intervals upto 40 days and slightly declined thereafter upto 60 days with subsequent storage. The maximum mean reducing sugars (6.15% and 6.21%) were recorded after 40 days in CFB and wooden boxes. The minimum mean reducing sugars (5.46%) were noted on day of harvest respectively, irrespective of packaging. The progressive increase in sugars during storage period upto 40 days and a gradual decline thereafter might be due to the hydrolysis of polysaccharides and concentration of juice as a result of dehydration with the increase in storage period there is constant increase in the reducing sugars due to conversion of starch and possibly of other organic acids and amino acids into reducing sugars. However on complete hydrolysis of starch, no further increase in sugars occurred (Wills *et al.,* 1980). Similar findings were obtained by Kaur *et al.* (2013) in Punjab Beauty fruits, Mahajan and Dhatt (2004) in Asian pear during cold storage, Paul (2002) in pear cv. Punjab Beauty and Kahlon (2007) in peach cv. Shan-i- Punjab. From the data it is evident that the fruits packed in CFB boxes after treatments showed significantly lower reducing, sugars (5.84%) than the fruits packed in wooden boxes (5.91%). Higher level of reducing

sugars in fruits packed in wooden boxes in comparison to CFB boxes might be due to the more moisture loss and faster rate of metabolic activities in wooden boxes resulting in breakdown of starch into sugars. The present study is in line with the findings of Kaur *et al.* (2013) in Punjab Beauty fruits and Kahlon (2007) in peach fruits.

It is evident from the data that there was increasing trend of total sugars upto 40 days and slightly declined thereafter upto 60 days of storage. The maximum mean total sugars (9.22% and 9.31%) were recorded after 40 days in CFB and wooden boxes respectively. The minimum mean total sugars (9.09%) was noticed on day of harvest irrespective of packaging. The increase in total sugars with the storage interval upto 40 days might be due to the hydrolysis of starch, yielding mono and disaccharides. Thereafter, decline could be attributed to metabolic break-down and senescence of fruit as a result of moisture and firmness loss during storage (Ryall and Pentzer, 1982). Similar findings were obtained by Kaur *et al.* (2013), Mahajan and Dhatt (2004) in Asian pear, Paul (2002) in pear cv. Punjab Beauty. From the data it is evident that the fruits packed in CFB boxes registered significantly lower total sugars (9.08%) as compared to fruits packed in wooden boxes (9.15%).The higher sugar content of fruits in wooden boxes might be the result of rapid loss of moisture and fast hydrolysis of starch and other polysaccharides to soluble form of sugars. These studies are in line with findings of Kaur *et al.* (2013) in Punjab Beauty fruits and Kahlon (2007) in peach fruits.

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