DOI : 10.5958/0974-0112.2017.00054.8

Indian J. Hort. 74(2), June 2017: 271-275

Effect of edible surface coatings on the storability of pear fruits

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ABSTRACT

Punjab Beauty is leading variety of semi-soft pear and commercially grown in Punjab. Fruits mature in third week of July, when temperature and humidity are very high, which reduces the shelf-life. An experiment was conducted to extend the post-harvest life of pear fruits using surface coatings such as carboxymethyl cellulose (CMC) @ 0.25%, *Aloe vera* gel (AVG) @ 0.25% and chitosan @ 0.25%. The control fruits were kept uncoated. Coated and control fruits were packed in CFB boxes and kept at 0-1°C and 90-95% relative humidity. Fruits were analysed for various physico-chemical characteristics, *viz*., PLW, palatability, TSS, acidity, total sugars, total phenolics and pectin methyl esterase activity after 30, 45, 60, 67 and 74 days of storage. Results revealed that all edible coatings had significant effect on quality parameters of fruits during storage period. After 67 days of storage, minimum PLW (5.16%) and highest palatability rating (7.10), total sugars (8.67%), total phenolics (60.3 mg/100 g FW) and PME activity (1.60 ml of 0.02 N NaOH) were recorded in carboxymethyl cellulose (CMC) @ 0.25% coated pear fruits. However, after 74 days of storage, fruits from all the treatments were of unacceptable quality. Carboxymethyl cellulose @ 0.25% was found to be the best coating to extend the post-harvest life of pear fruits up to 67 days under cold storage conditions.

Key words: Pear, storage, surface coatings, fruit quality, post-harvest.

INTRODUCTION

Low chill varieties of pear are being cultivated successfully under sub-tropics of northern India. In Punjab, several semi-soft varieties of pear have been recommended for cultivation, but Punjab Beauty is most popular among the growers. Fruits of this variety mature in the third week of July, when the temperature and humidity are very high, which reduces the shelf-life of fruits. Modified atmosphere packaging has been used in the recent past to extend the storage life of fruits (Nath *et al*., 8). However, non-biodegradable nature of polyethylene films and even high carbon dioxide injury, ethanol production and off-flavour development due to anaerobic respiration, poses several problems. Keeping this in view, fruit coatings can be considered as eco-friendly alternate to the polyethylene films. Semi-permeable coatings can create a modified atmosphere similar to CA storage, which is less expensive. The atmosphere created by various surface coatings depends on the prevailing environmental conditions. Coatings are also used to extend the shelf-life of fruits and to improve appearance. Edible coatings are conventionally used to improve and maintain the fruit appearance due to their eco-friendly nature (Petersen *et al*., 9). Coatings act as barrier to moisture loss and gaseous exchange during handling and storage, retards food deterioration and enhances its safety (Cha and Chinnan, 3). Thus, the present study was conducted to evaluate the efficacy of different coatings for extending the storage life of pear cv. Punjab Beauty under low temperature storage conditions.

MATERIALS AND METHODS

The present investigation was carried out during 2014 in Post-harvest Laboratory, Department of Fruit Science, PAU, Ludhiana. Physiologically mature fruits of pear cv. Punjab Beauty were harvested from pear orchard at Fruit Research Farm during morning hours. Fruits showing deformities were discarded and only healthy and uniform fruits were selected for the experiment. Fruits were washed, air-dried and subjected to various coatings, *viz*., Carboxymethyl cellulose (CMC) @ 0.25%, *Aloe vera* gel (AVG) @ 0.25%, Chitosan® @ 0.25%. An aqueous solution of *Aloe vera* gel was prepared by diluting 2.5 g *Aloe vera gel* freeze dried powder to 1 l with distilled water and 0.05% Tween 20 as a surfactant. To prepare 1 l solution of chitosan® (0.25%), 2.5 g of chitosan® was dissolved in 900 ml distilled water containing 1% acetic acid, then the pH of the solution was maintained at 5.0 with 2 mol/l NaOH and made upto 1 l. The control fruits were given water dip only. Twenty fruits were taken in each replication of each treatment. After coatings, fruits were dried in air and packed in CFB boxes with paper lining and paper cuttings as cushioning material and were kept at 0-1°C and 90-95% relative

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humidity. The data on physiological loss in weight (PLW), palatability rating, TSS, acidity, total sugars, total phenolics and pectin methyl esterase (PME) activity were recorded after 30, 45, 60, 67 & 74 days of storage. The PLW of fruits was calculated on initial weight basis. The per cent loss in weight after each storage interval was calculated by subtracting final weight from the initial weight of the fruits and then converted into percentage value. Experimental fruits were evaluated for sensory quality (palatability) by a panel of five judges. A nine point 'Hedonic scale' was used for its inference (Amerine *et al.*, 2). Total soluble solids (TSS) were determined with the help of hand refractometer (Erma, Japan) and expressed in per cent. The readings were corrected with the help of temperature correction chart at 20°C temperature. Acidity was determined by titrating 2 ml of strained juice of fruits against 0.1 N NaOH solution using phenolphthalein as an indicator. The titratable acidity was calculated and expressed in terms of percent maleic acid. Total sugars were estimated by following the AOAC (1) method. Phenolics were estimated as total tannins after developing colour with Folin-Denis's reagent (AOAC, 1) method and expressed in mg/100 g fresh weight (FW). For estimation of Pectin methyl esterase activity, enzyme extract was prepared by taking 20 g fruit pulp which was blended in 60-100 ml NaCl solution (0.15 ml), filtered through two layers of cheese cloth, centrifuged at 2,000 rpm for 30 min. at 4°C. The supernatant was used as an enzyme source (Mahadev and Sridhar, 7).

The experiment was laid out in completely randomized block design (Factorial) and data were analyzed for analysis of variance using statistical software SAS 9.3 (SAS Institute Inc., Cary, NC, USA).The means were compared using LSD test at significance level of 0.05.

RESULTS AND DISCUSSION

Physiological loss in weight of fruit contributes toward the post-harvest losses. The rate of water loss from the fruits affects its post-harvest life. Various fruit coatings showed significant differences in PLW of pear during storage as compared to control (Fig. 1a). PLW increased linearly with the advancement of storage period, but after 74 days maximum loss in weight was recorded, while minimum was recorded after 30 days of storage period. After 67 days of storage, maximum (6.87%) PLW was found in control, while the minimum (5.16%) was found in CMC @ 0.25% treated fruits. Similar results were also reported in pear and peach fruits (Togrul and Arslan, 13). Climacteric mature fruits when detached from tree undergoes a series of metabolic processes, which ultimately results in loss of weight (Wills *et al.*, 15).

Palatability rating (PR) depicts the consumer acceptability of the fruit. PR increased gradually up to 45 days of storage, but thereafter a decline was observed in all the treatments (Fig. 1b). Fruits treated with CMC @ 0.25% were found in moderately acceptable condition after 67 days of storage with 7.10 palatability rating score whereas, control fruits registered the minimum (3.25) palatability rating. The retention of high palatability in coated fruits may be due to lower physiological loss in weight, maintenance of higher fruit firmness, TSS and acid content.

Total soluble solids of the stored fruits showed a significant difference with storage time and treatments (Fig. 1c). An increase in TSS was observed with the advancement of storage period in all the treatments but this increase was registered up to 45 and 67 days of storage in control and CMC @ 0.25% treated fruits, respectively. Similar to this increase in TSS with storage period has been reported by Singh and Janes (12). Effective changes in TSS are naturally occurring phenomenon and might be correlated with the hydrolytic changes in starch concentration during post-harvest storage period as reported by Wills *et al*. (14). After 74 days of storage CMC @ 0.25% coated fruits retained the highest (12.70%) level of TSS and lowest (12.3%) was recorded in control. Similarly, the fine coating of sago (10%) increased shelf-life of custard apple fruits with high total soluble solids in zero energy cool chamber (Jholgiker and Reddy, 5).

Acidity of pear fruits experienced a decrease, followed by an increase with the advancement of storage period (Fig. 1d). Decline in acidity was recorded up to 60 days of storage in all the treatments except CMC @ 0.25% treatment where this decrease was recorded up to 67 days. With the utilization of organic acid in pyruvate decarboxylation reaction during the ripening process of fruits a decrease in titratable acids during storage occurs as also suggested by Rhodes *et al.* (11). An increase in acidity at the end of storage indicates the deterioration of fruit quality.

Total sugars of the stored fruits increased during the initial periods of storage, but thereafter a decline in total sugars was recorded in all the treatments (Fig. 2a). After 30 days of storage, highest total sugars were recorded in untreated fruits, but after 45 days of storage a decline was observed. In coated fruits increase in total sugars was observed upto 60 days of storage except CMC @ 0.25% coated fruits, where this increase was observed upto 67 days of storage. Decline in sugar content at the end of storage depicts the deterioration of fruit quality. At the end of storage, fruits coated with CMC @ 0.25% retained the highest (8.54%) total sugars content as compared to other treatments. The increase in sugars during storage

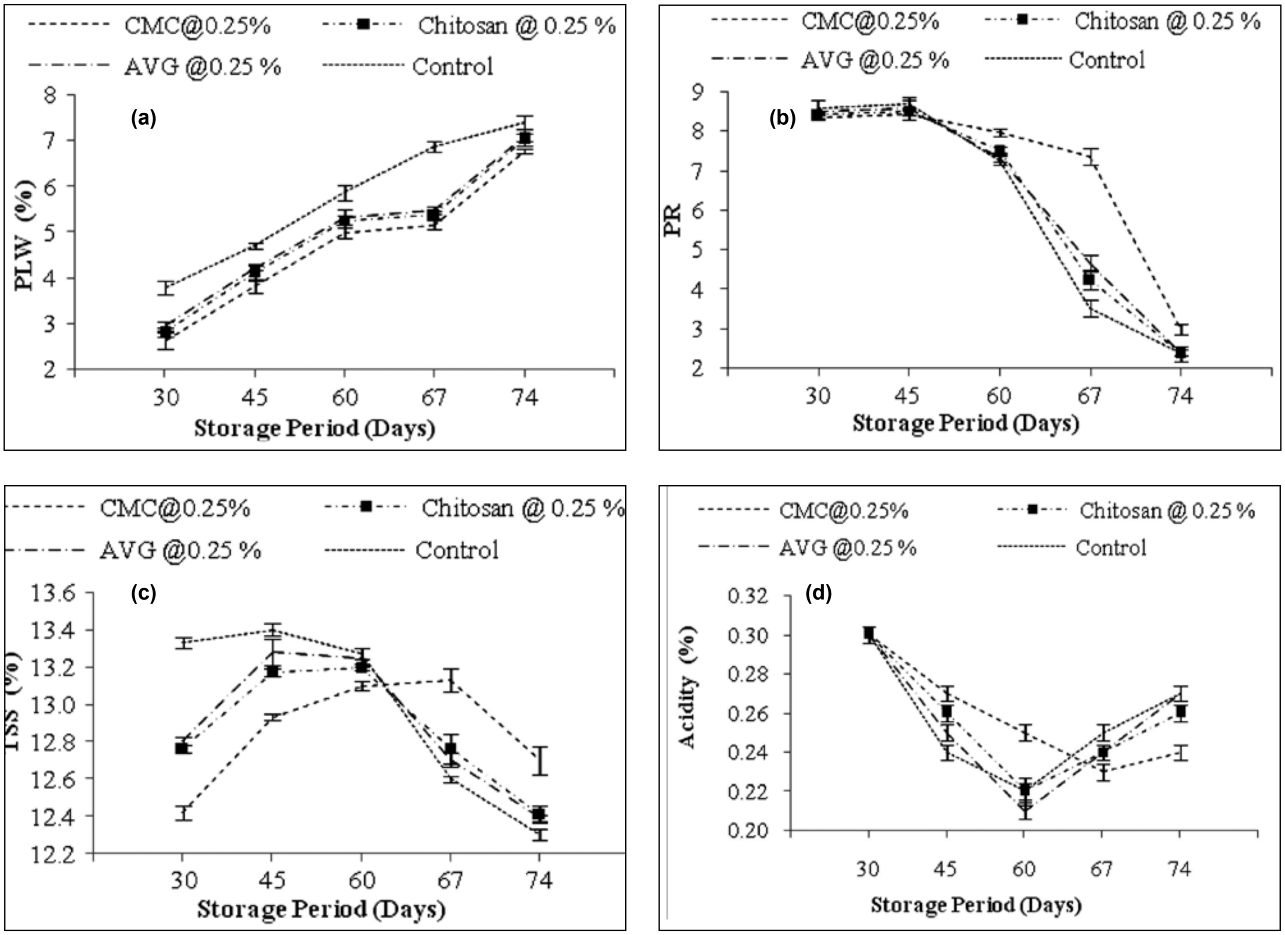

Fig. 1. Effect of post-harvest treatments on (a) PLW, (b) PR, (c) TSS and (d) acidity of pear fruits during storage. Vertical bars represent ± SE of mean.

may possibly be due to breakdown of complex organic metabolites into simple molecules or due to hydrolysis of starch into sugars. The decline in the sugar content at the later stages of storage may be due to the utilization of sugars in metabolic processes of the fruit. Similar results were also reported by Kaur *et al.* (6). Phenols are the important antioxidants and their content gradually declines with the ripening of fruits. In all the treatments total phenolics content declined with the extension in storage period (Fig. 2b), but this decline was slow in coated fruits as compared to untreated (control) fruits. It may be due to the low activity of polyphenol oxidase (PPO) enzyme in coated fruits. Similarly, reduction in total phenols during storage of peach fruits was observed by Jawandha *et al.* (4). During the entire storage period, highest total phenolics were recorded in fruits coated with CMC @ 0.25%. At the end of storage maximum (48.2 mg/100 g FW) total phenols were registered in CMC @ 0.25% treated fruits, whereas minimum (44.1 mg/100 g FW) were found in control fruits followed by fruits coated with AVG @ 0.25%. High retention of phenols in coated fruits may be due to the reduction in rate of phenols oxidation by various coatings.

Pectin methyl esterase activity affects the fruit texture and rigidity of cell wall. An increase in PME activity was recorded in all the treatments during the early periods of storage, but on the later stages of storage a decline in PME activity was recorded (Fig. 2c). All the treatments showed an increase in PME activity up to 60 days of storage except control and CMC @ 0.25% treatment, where this increase was recorded up to 45 days and 67 days of storage, respectively. At the end of storage, highest (1.28 ml of 0.02 N NaOH) PME activity was recorded in CMC @ 0.25% coated fruits, it may be due to the availability of more substrate (pectin) for enzyme activity in CMC @ 0.25% coated fruits, which was exhausted at earlier stages of storage in other treatments. Similar results were reported in *ber* fruits by Randhawa *et al*. (10).

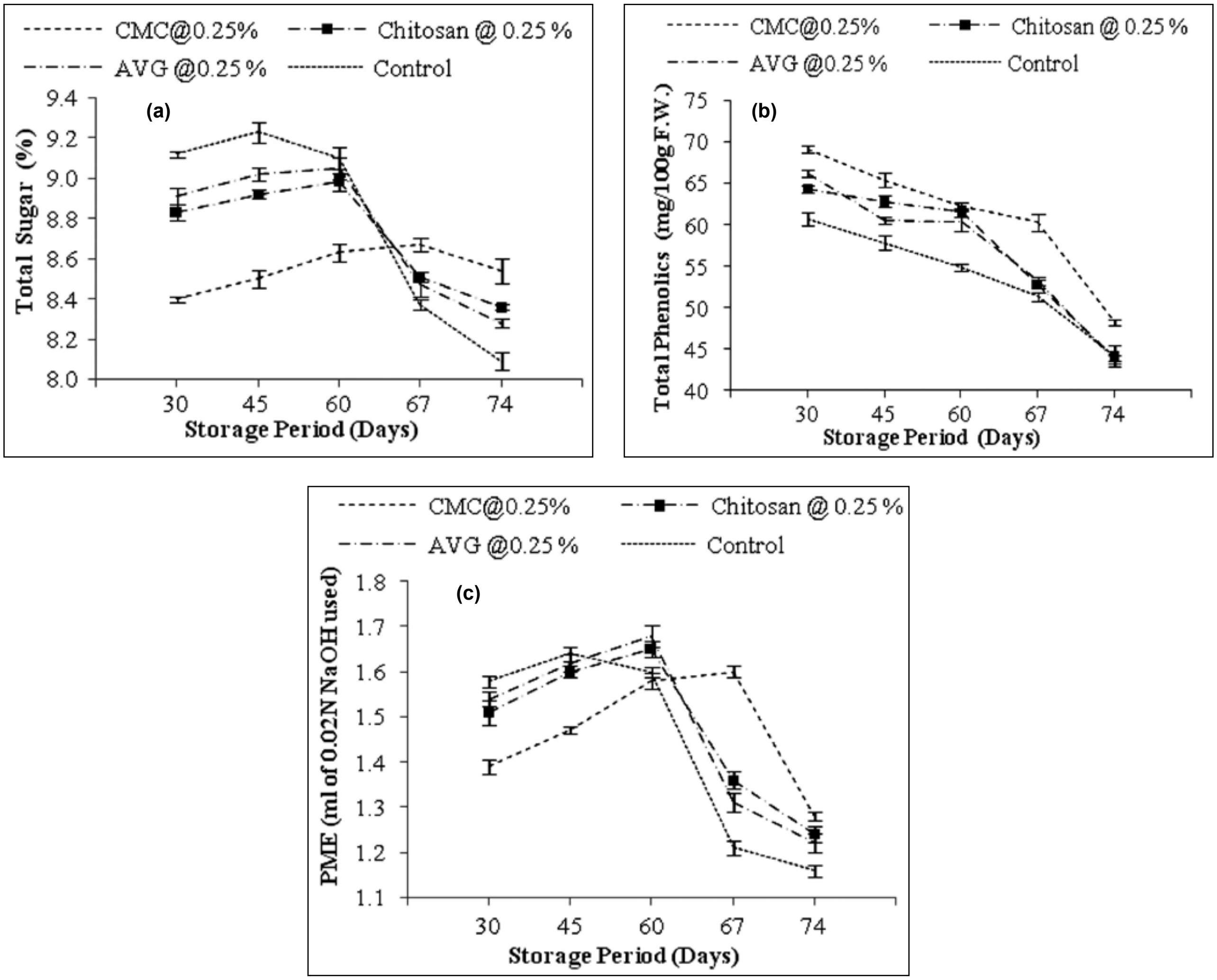

Fig. 2. Effect of post-harvest treatments on (a) total sugars, (b) total phenolics and (c) PME of stored pear fruits. Vertical bars represent ± SE of mean.

Results from this research showed that pear fruits coated with carboxymethyl cellulose (CMC) @ 0.25% can be stored for 67 days with moderately acceptable quality under cold storage conditions.

ACKNOWLEDGEMENT

The authors gratefully acknowledge the financial support of University Grant Commission, New Delhi thorough their project F.No.42-720/2013 (SR).

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Received : October, 2016; Revised : April, 2017;
Accepted : May, 2017