Applied Biological Research 18 (1): 71-75; (2016) **SHORT COMMUNICATION**
DOI: 10.5958/0974-4517.2016.00011.2

INFLUENCE OF POST HARVEST CALCIUM CHLORIDE TREATMENT AND SHRINK FILM PACKAGING ON STORAGE LIFE OF PEAR FRUITS

P.P.S. Gill, S.K. Jawandha, Anil Sangwan, Nav Prem Singh and Navdeep Kaur

Department of Fruit Science, Punjab Agricultural University, Ludhiana- 141004, Punjab (India)
*e-mail:*parmpalgill@pau.edu*

(Received 22 December, 2015; accepted 2 March, 2016)

ABSTRACT

To enhance the storage life of pear cv. 'Punjab Beauty', fruits were dipped in aqueous solution of calcium chloride (1.5 and 2.5%) for 5 min., packed in corrugated fibre board (CFB) boxes or shrinkfilm trays and stored at 0-1°C with 90-95% RH for 67 days. Untreated fruits were dipped in fresh water only and kept in CFB boxes. The weight loss was appreciably reduced in $CaCl_2$ treated + shrink wrapped fruits. $CaCl_2$ treatment @ 1.5% and shrink film tray packaging proved effective in maintaining the firmness and acid content of fruits. Maximum sensory quality of fruits was recorded after 45 days in fruits treated with $CaCl_2$ @ 2.5% + CFB packing. Soluble solids content in fruit juice was highest after 60 day of storage in all the treatments. Combination of shrink film tray packaging + $CaCl_2$ @ 1.5% treatment was effective in minimizing the physiological loss in weight of fruits and maintaining the fruit quality for 60 days under storage.

Keywords: Calcium chloride, fruit quality, pear, shrink film tray packaging, storage

INTRODUCTION

Pear is an important temperate fruit but can also be grown successfully under subtropical conditions because of its wide climatic and soil adaptability. 'Punjab Beauty' is a leading cultivar of semi-soft pear cultivated in subtropics of northwestern India. Fruits are harvested at mature green stage (at colour break) during the 3rd week of July. During this period temperature is relatively high (30-35°C) and at ambient conditions pear fruit has short shelf life of 7-9 days. This leads to the glut in market at harvest time and force the growers to dispose-off their produce at lower prices.

Proper storage techniques increase the shelf life of fruits and also regulate market supply. Calcium is known to strengthen the cell structure by maintaining fibrilar packaging in cell walls, thus reinforcing cell to cell contact which is related to the formation of calcium pectate and counter-acts the pectin methyl esterase activity (Alandes *et al.*, 2009). Rapid urbanization growth has lead to the development of super-market industry wherein fresh fruits and vegetables have become important components of these stores. There exists great demand by consumers for well presented shrink film tray packaged fruits. This technique further contributes in extending the shelf-life by preventing the moisture loss, reducing the respiration rate and maintaining the firmness. Modified atmosphere packaging improves the shelf-life of pear fruits under ambient conditions (Nath *et al.*, 2012). Limited work has been done on combined use of calcium treatments and polyethylene packaging on storage behaviour of sub-tropical pears (Kaur *et al.*, 2011). Therefore, the present study was conducted to investigate the potential utilization of calcium chloride and role of shrink film tray packaging as a post harvest tool to maintain quality and extend post harvest life of pear cv. ‘Punjab Beauty’ in cold storage.

MATERIALS AND METHODS

The experiment was carried out in Post Harvest Laboratory, Department of Fruit Science, PAU, Ludhiana (India) during the year 2014. Uniform sized, free from external defect fruits of pear cv. ‘Punjab Beauty’ were picked along with pedicel from Fruit Research Farm of the Department in morning hours and transported immediately to the laboratory. The fruits were dipped in aqueous solution of calcium chloride (1.5 and 2.5%) for 5 min. and air dried. Subsequently fruits were shrink film wrapped along with paper moulded trays using shrink packaging system (Weldotron 7030, USA). Calcium salt treated fruits without shrink packaging were placed in corrugated fibre board boxes (CFB). Similarly, control fruits were given water dip only and packed in CFB. All the packages were kept in cold chamber at 0-1°C and 90-95% RH. Physiochemical analysis of fruits was done after 30, 45, 60 and 67 days of storage. Physiological loss in weight (PLW) was noted by subtracting final fruit weight from initial fruit weight and expressed as percent loss in weight. The weight loss was calculated by using the formula: $W_{l} =$ (Wi-Wf/Wi) x 100; where W_l is the weight loss (%), Wi (g) and Wf (g) are the initial and final weights, respectively. 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 skin was peeled-off and the tip of penetrometer was inserted in fruit from both sides to record firmness and expressed in kgf. For soluble solids content (SSC) determination, the fruits were meshed and juice obtained was filtered through a cheese cloth. SSC was measured by digital refractometer (ATAGO, PAL-1, model 3810, Japan) by placing 1-2 drops of juice on prism of refractometer and readings expressed in ^{o}Brix.

Titratable acidity was estimated by titrating 2 mL strained fruit juice against 0.1 N NaOH solution using phenolphthalein as an indicator. The sensory quality of fruits was observed and rated by in house panel of 10 judges on the basis of appearance, flavour, texture and overall acceptability using nine point hedonic scale (1-9). Experiment was laid out in a completely randomized block design and data analyzed for the analysis of variance (Proc GLM) using statistical package SAS 9.3 (SAS system for Windows, version 9.3, SAS Institute, Cary, NC). Means were separated using Fischer’s LSD test at $p<0.05$.

RESULTS AND DISCUSSION

Loss in weight of fruits increased with progressive increase in storage period in all treatments including control (Table 1). $CaCl_2$ treatment (1.5 and 2.5%) significantly reduced the weight loss (4.86 and 4.75%) compared to control (5.46%) upto 60 days of storage. $CaCl_2$ treatment + shrink film packing fruits had substantially less weight loss as compared to $CaCl_2$ treatment + CFB packed fruits. No significant difference was observed between the $CaCl_2$ concentration of 1.5 and 2.5% for weight loss in both shrink film and CFB packing upto 60 days. The reduction in weight loss in film-packed fruits may be attributed to lower moisture loss due to maintenance of higher humidity inside the packaging films (Ben-Yehoshua *et al.*, 1979). Polymeric film packaging was more effective in lowering the weight loss in fruit during cold storage. The findings are supported by Pongener *et al.* (2010) who reported that shrink and LDPE film packaging reduced weight loss and extended fruit shelf life. Similar reduction in weight loss by calcium treatments have been reported by Randhawa *et al*. (2009).

Table1: Effect of post harvest $CaCl_2$ treatment and packaging on physiological loss in weight, firmness, soluble solid content, sensory rating and titratable acidity of pear fruit

Treatments	Storage period (days)			
	30	45	60	67
Physiological loss in weight (%)				
$CaCl_2$ (1.5%) + CFB box packing	2.98 ± 0.10^b	3.48 ± 0.14^b	4.86 ± 0.11^b	5.63 ± 0.17^a
$CaCl_2$ (2.5%) + CFB box packing	2.75 ± 0.09^b	3.40 ± 0.11^b	4.75 ± 0.14^b	5.23 ± 0.15^b
$CaCl_2$ (1.5%) + shrink film tray packaging	0.20 ± 0.01^c	0.24 ± 0.02^c	0.31 ± 0.02^c	0.53 ± 0.04^c
$CaCl_2$ (2.5%) + shrink film tray packaging	0.24 ± 0.01^c	0.28 ± 0.01^c	0.59 ± 0.02^c	0.69 ± 0.03^c
Control	3.51 ± 0.10^a	4.49 ± 0.16^a	5.46 ± 0.18^a	5.90 ± 0.16^a
$CD_{0.05}$	0.0001	0.0001	0.0001	0.0001
Firmness (kgf)				
$CaCl_2$ (1.5%) + CFB box packing	4.90 ± 0.13^a	3.95 ± 0.11^a	2.95 ± 0.04^b	2.27 ± 0.07^a
$CaCl_2$ (2.5%) + CFB box packing	5.06 ± 0.10^a	4.08 ± 0.13^a	3.12 ± 0.10^{ab}	2.39 ± 0.06^a
$CaCl_2$ (1.5%) + shrink film tray packaging	5.13 ± 0.12^a	4.19 ± 0.13^a	3.24 ± 0.06^a	2.33 ± 0.06^a
$CaCl_2$ (2.5%) + shrink film tray packaging	5.15 ± 0.13^a	4.00 ± 0.11^a	3.09 ± 0.07^{ab}	2.13 ± 0.07^a
Control	4.44 ± 0.12^b	3.68 ± 0.12^a	2.72 ± 0.07^c	2.16 ± 0.10+
$CD_{0.05}$	0.0048	0.0791	0.0012	0.1121
Soluble solids content (%)				
$CaCl_2$ (1.5%) + CFB box packing	12.42 ± 0.06^b	13.00 ± 0.07^{ab}	13.25 ± 0.07^{ab}	12.90 ± 0.05^{ab}
$CaCl_2$ (2.5%) + CFB box packing	12.36 ± 0.07^b	12.85 ± 0.12^b	13.08 ± 0.07^{bc}	13.01 ± 0.11^a
$CaCl_2$ (1.5%) + shrink film tray packaging	12.35 ± 0.09^b	12.56 ± 0.10^c	12.88 ± 0.08^{cd}	12.83 ± 0.02^{ab}
$CaCl_2$ (2.5%) + shrink film tray packaging	12.38 ± 0.07^b	12.53 ± 0.10^c	12.85 ± 0.07^d	12.80 ± 0.08^{bc}
Control	13.02 ± 0.08^a	13.18 ± 0.09^a	13.31 ± 0.08^a	12.60 ± 0.03^c
$CD_{0.05}$	0.0001	0.0009	0.0014	0.0099
Sensory rating (1-9)				
$CaCl_2$ (1.5%) + CFB box packing	8.31 ± 0.09^a	8.16 ± 0.27^a	7.01 ± 0.17^a	6.18 ± 0.17^a
$CaCl_2$ (2.5%) + CFB box packing	8.20 ± 0.15^a	8.41 ± 0.20^a	7.14 ± 0.17^a	6.22 ± 0.16^a
$CaCl_2$ (1.5%) + shrink film tray packaging	8.19 ± 0.10^a	8.21 ± 0.22^a	6.82 ± 0.21^a	5.92 ± 0.17^a
$CaCl_2$ (2.5%) + shrink film tray packaging	8.11 ± 0.10^a	8.02 ± 0.21^a	6.21 ± 0.19^b	5.41 ± 0.16^b
Control	7.89 ± 0.16^a	7.28 ± 0.19^b	6.71 ± 0.15^{ab}	5.83 ± 0.16^{ab}
$CD_{0.05}$	0.2287	0.0220	0.0195	0.0210
Titratable acidity (%)				
$CaCl_2$ (1.5%) + CFB box packing	0.288 ± 0.01^{bc}	0.249 ± 0.01^{cd}	0.224 ± 0.01^{bc}	0.201 ± 0.01^b
$CaCl_2$ (2.5%) + CFB box packing	0.304 ± 0.01^b	0.271 ± 0.01^{bc}	0.246 ± 0.01^{ab}	0.214 ± 0.01^b
$CaCl_2$ (1.5%) + shrink film tray packaging	0.312 ± 0.01^b	0.293 ± 0.00^{ab}	0.267 ± 0.01^a	0.246 ± 0.01^a
$CaCl_2$ (2.5%) + shrink film tray packaging	0.347 ± 0.01^a	0.312 ± 0.01^a	0.272 ± 0.01^a	0.259 ± 0.01^a
Control	0.263 ± 0.01^c	0.235 ± 0.01^d	0.205 ± 0.01^c	0.216 ± 0.01^b
$CD_{0.05}$	0.0001	0.0001	0.0004	0.0003

Fruit firmness is the most reliable factor to determine the extent to which the pear fruit is ripened. At the time of storage the pear fruits were hard in texture but with storage period fruits started losing firmness regardless of treatment given (Table 1). Fruit softening is due to degradation of polysaccharides and alterations in the bonding between polymers which cause an increase in cell separation and softening and swelling of wall, which along with the alterations in turgor brings about fruit softening and textural changes (Brummell, 2006). Firmness of fruits by $CaCl_2$ treatments in CFB or with shrink tray packaging was significantly higher as compared to control at 30 and 60 days of storage, whereas, it was non-significant amongst all treatments at 45 and 67 days of storage. After 30days of storage, maximum firmness (5.15 kgf) was retained by fruits under $CaCl_2$ 2.5% + shrink film tray packaging treatment and minimum was recorded in control fruits (4.44 kgf). Gupta *et al.* (2011) also found that fruit firmness decreased gradually during storage, but the rate of decrease in firmness was slower in $CaCl_2$ treated peach fruits. It was observed that calcium chloride dip and shrink film packaging helps in maintaining fruit firmness for extended period of time.

Soluble solids content exhibited an increasing trend up to 60 days of storage and afterwards declined despite treated or control. Untreated fruits showed highest soluble solids in contrast to calcium treated fruits both in CFB and shrink film tray packed fruits (Table1). Enhancement in SSC during storage might be due to conversion of pectic substances and starch hydrolysis (Goncalves *et al.*, 2000, Carrillo *et al.*, 2003). The rate of increase in SSC with storage in shrink packed fruits was lower than control. $CaCl_2$ treated + shrink film tray packaged fruits had significantly lower SSC as compared to control fruits upto 60 days of storage. This may be due to the production of higher levels of CO_2 in polymeric film packaging (Nath *et al.*, 2012). At the end of storage, maximum SSC (13.1^{o}Brix) was retained by 2.5% $CaCl_2$ treated fruits with CFB packing.

In all treatments the sensory rating improved up to 30 days of storage then slowly declined up to end of storage, except in 2.5% $CaCl_2$ + CFB packed fruits and $CaCl_2$ 1.5% + shrink film packed fruits, where it improved upto 45 days of storage (Table 1). At 30th day of storage, no significant difference was observed in sensory rating of fruits among various treatments. At 45 day of storage, control fruits had lowest (7.28) sensory rating. While after 2 months, significantly lower score was observed for $CaCl_2$ 2.5% + shrink film packed fruits as compared to other calcium treatments. At the end of storage maximum palatability (6.22) was noted in $CaCl_2$ (2.5%) + CFB treated fruits. The higher sensory quality rating of calcium treated fruits storage might be due to the retardation of ripening and softening process of fruit that led to the development of better juiciness, texture, flavour and sweetness (Jawandha *et al.*, 2014).

The acid content of fruit juice declined with storage for $CaCl_2$ treated fruits, whereas for control fruits decline was observed till 60 days of storage. The acid content of fruits at the end of storage period (67th day) was about 1.5 times lesser than at the harvest period (0 day). Highest juice acid content throughout the storage period was recorded in $CaCl_2$ 2.5% + shrink film packed fruits followed by $CaCl_2$ 1.5% with shrink film packed fruits. As compared to other treatments lower juice acidity was recorded in control fruits at all storage intervals, except at 67 days of storage where it was lower than shrink wrapped treatments. Similar decline in acid content during storage has been reported Bhat *et al.* (2010) in Bartlett pear. From this study it can be inferred that $CaCl_2$ (1.5%) + shrink film tray packaging treatment reduced PLW and prolonged the storage life of Punjab Beauty pear fruits up to 60 days at low temperature storage.

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