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EFFECT OF CALCIUM NITRATE AND GIBBERELLIC ACID ON STORAGE LIFE OF PEAR (*Pyrus pyrifolia*) cv. NIJISSEIKI

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ABSTRACT

Fruits of pear (*Pyrus pyrifolia*) *cv.* Nijisseiki are vulnerable to post-harvest losses as its maturity time in north India coincides with summer months. Hence, to improve the storage life, the fruits were given post-harvest dip of calcium nitrate @ 0, 2, 3 and 4% and gibberellic acid (GA_3) @ 0, 20, 40 and 60 ppm for 5 min. Treated and untreated (control) fruits were packed in CFB boxes and stored at low temperature conditions (0-1ºC and 90-95% R.H) for 70 days. Fruits were analyzed for various physicochemical changes on 0, 30, 50 and 70 days after storage. Both calcium nitrate and GA_3 treatments were effective in minimizing the physiological loss in weight (PLW) and maintaining the fruit firmness, total soluble solids (TSS), titratable acidity, total sugars content, sensory quality and pectin methyl esterase (PME) activity as compared to control during storage period. After 70 days of storage, minimum PLW (4.81%) and highest fruit firmness (3.88 kgf), sensory quality (7.15), TSS (12.35%) total sugars (8.45%), and PME activity (1.31 ml of 0.02 N NaOH used) were recorded in 3% calcium nitrate treated fruits.

Key words: Calcium nitrate, fruit quality, gibberellic acid, pear, storage

INTRODUCTION

Pear is an important temperate fruit successfully grown under sub-tropical conditions of Punjab owing to its wide agro-climatic adaptability. 'Nijisseiki' is a brown coloured soft textured flesh pear variety. It is harvested in the 1st week of July when weather is hot and humid so is prone to heavy post-harvest losses. There is urgent need to contrive suitable technique that could reduce such losses and maintain fruit quality during storage. Several strategies have been used to restrict deteriorative processes in harvested fruits which include controlled atmosphere storage, modified atmosphere storage and ethylene management. However, due to lack of infrastructure and CO_2 injury in other methods, the use of calcium salts and growth regulators seem convenient to adopt at grower's level.

Calcium is an essential mineral constituent of middle lamellae of cell wall. It reduces fruit softening and increases storage life of fruits (White and Broadley, 2003). Gibberellic acid (GA_3) is a plant growth regulator that retards ripening and senescence in fruits. Pear fruit *cv.* 'Punjab Beauty' treated with GA_3 (50 ppm) showed higher organoleptic rating than untreated ones after 60 days of cold storage (Sandhu *et al.*, 2004). Similarly, postharvest use of calcium nitrate ($CaNO_3$) @ 2.0% improved storage life of pear cv. Punjab Beauty (Sonia *et al.*, 2016). Recently, pear variety 'Nijisseiki' has been recommended for sub-tropical areas of north-western India and no report on the effects of post-harvest use of GA_3 or $CaNO_3$ on storage life and quality of its fruits is available. Hence, the present study was aimed to assess the efficacy of $CaNO_3$ and GA_3 on storage life of 'Nijisseiki' pear fruits.

MATERIALS AND METHODS

Physiologically mature pear fruits of *cv*. Nijisseiki, free from external defects, were harvested from the Fruit Research Farm, PAU, Ludhiana (India) during the year 2015 and immediately brought to Post Harvest Laboratory, Department of Fruit Sciences. Randomly selected and pre-weighted fruits (20 fruits/replication) were treated with $CaNO_3$ @ 2, 3 and 4% and GA_3 @ 20, 40 and 60 ppm for 5 min. The control fruits were given water dip. The fruits were air-dried, packed in corrugated fiber board (CFB) boxes and stored at 0-1°C and 90-95% RH (Thermo-hygrometer, Fisher Scientific™ 11-661-13) for 70 days and analyzed for various physicochemical changes after 0, 30, 50 and 70 days of storage. Twenty fruits were taken per replication of each treatment. The physiological loss in weight of fruits was recorded by subtracting the final fruit weight from initial fruit weight and expressed as percent weight loss with reference to the initial weight. Fruit firmness was measured with the help of a standard mounted penetrometer (Model FT-327, USA) and expressed as kgf. Experimental fruits were evaluated for sensory quality by a panel of five judges. A 9-point 'hedonic scale' was used for its inference (Amerine *et al*., 1965). The fruits were rated as: 9 (extremely desirable), 8 (very much desirable), 7 (moderately desirable), 6 (slightly desirable), 5 (neither desirable nor undesirable), 4 (slightly undesirable), 3 (moderately undesirable), 2 (very much undesirable), 1 (extremely undesirable). Total soluble solids content was measured with digital refractometer (ATAGO, PAL-1, model 3810, Japan). Titratable acidity was estimated by titrating 2.0 mL juice against 0.1 N NaOH using phenolphthalein as indicator. Pectin methyl esterase activity was determined as per method described by Mahadevan and Sridhar (1982). The experiment was laid out in a completely randomized design (factorial) and data were analyzed by the analysis of variance (Proc GLM) 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

The physiological loss in weight in fruits increased with increase in storage interval, irrespective of the treatments (Table 1). Both $caNO_3$ and GA_3 treatments significantly lowered PLW as compared to untreated fruits. The increase in PLW with storage was primarily due to loss of moisture from fruits

Table 1: Effect of post-harvest treatments on physiological loss in weight (PLW) and firmness of pear fruits during cold storage

Treatments	Physiological loss in weight (%)					Firmness (kgf)				
	Storage period (days)					Storage period (days)				
	0	30	50	70	Mean	0	30	50	70	Mean
$CaNO_3$ 2%	0.0	2.81	3.53	5.43	2.94	5.79	5.40	4.48	3.65	4.83
$CaNO_3$ 3%	0.0	2.55	2.78	4.81	2.54	5.78	5.65	4.84	3.88	5.04
$CaNO_3$ 4%	0.0	2.62	3.08	5.17	2.72	5.79	5.42	4.73	3.71	4.92
GA_3 20 ppm	0.0	3.42	4.27	5.83	3.38	5.78	5.18	4.41	3.53	4.73
GA_3 40 ppm	0.0	3.37	4.19	5.72	3.32	5.78	5.23	4.47	3.55	4.76
GA_3 60 ppm	0.0	2.98	3.72	5.59	3.07	5.79	5.11	4.50	3.55	4.74
Control	0.0	4.25	5.12	7.11	4.12	5.78	4.82	3.74	2.72	4.27
Mean	0.00	3.14	3.81	5.67		5.79	5.26	4.45	3.52	4.76
$CD_{0.05}$										
Treatment(t)			0.30					0.46		
Storage (s)			0.22					0.35		
s × t			0.61					0.92		

Table 2: Effect of post-harvest treatments on TSS, total sugars and titratable acidity of pear fruits during cold storage

Treatments	TSS (%) Storage period (days)					Total sugars (%) Storage period (days)					Titratable acidity (%) Storage period (days)				
	0	30	50	70	Mean	0	30	50	70	Mean	0	30	50	70	Mean
$CaNO_3$ 2%	10.55	12.25	12.50	12.22	11.88	7.39	8.33	8.58	8.41	8.18	0.32	0.27	0.23	0.22	0.26
$CaNO_3$ 3%	10.57	12.00	12.38	12.35	11.83	7.35	8.11	8.48	8.45	8.10	0.31	0.29	0.26	0.25	0.28
$CaNO_3$ 4%	10.55	12.15	12.49	12.25	11.86	7.32	8.29	8.56	8.42	8.15	0.31	0.29	0.24	0.21	0.26
GA_3 20 ppm	10.58	12.53	12.74	12.22	12.02	7.37	8.56	8.68	8.32	8.23	0.31	0.24	0.21	0.20	0.24
GA_3 40 ppm	10.55	12.42	12.68	12.23	11.97	7.35	8.48	8.65	8.34	8.21	0.32	0.25	0.21	0.20	0.25
GA_3 60 ppm	10.56	12.38	12.55	12.31	11.95	7.34	8.38	8.63	8.38	8.18	0.32	0.25	0.23	0.21	0.25
Control	10.58	14.15	13.98	12.01	12.68	7.37	9.07	9.77	7.89	8.53	0.31	0.21	0.20	0.15	0.22
Mean	10.56	12.55	12.76	12.23		7.36	8.46	8.76	8.32		0.32	0.26	0.23	0.21	
$CD_{0.05}$															
Treatment (t)			0.24					0.33					0.01		
Storage (s)			0.18					0.25					0.08		
s × t			0.47					0.68					0.02		

which also resulted in fruit softening. The fruit firmness significantly decreased with advancement of storage period (Table 1). During the entire storage period, calcium treatments were more effective than GA_3 treatments in maintaining the fruit firmness. After 70 days of storage, minimum PLW (4.81%) and maximum fruit firmness (3.71 kgf) were recorded in 3% $CaNO_3$ treated fruits while control fruits showed maximum PLW (7.11%) and minimum fruit firmness (2.72 kgf). Similar observations have been reported by Bandey (1996) who found that post-harvest applications of calcium and GA_3 treatments lowered the loss in weight of 'Le-Conte' pear fruits as compared to the untreated fruits.

The fruit quality parameters like TSS and total sugars were significantly affected by $CaNO_3$ and GA_3 treatments (Table 2). There was increase in TSS and total sugars content up to 50 days of storage, followed by a slight decline at the end of storage in both the parameters. An increase in TSS was probably attributed to the enzymatic conversion of higher polysaccharides such as starch and pectin into simple sugars during ripening (Hussain *et al*., 2008). As compared to control post-harvest treatments of $CaNO_3$ and GA_3 slowed down TSS and total sugars accumulation in fruits with storage. However, at the end of storage maximum TSS (12.35%) and total sugars (8.45%) were found in 3% $CaNO_3$ treatment, whereas untreated fruits had minimum sugar accumulation. This may be due to the reduction in metabolic activities like respiration and senescence by $CaNO_3$ and GA_3 treatments. These results are supported by the findings of Islam *et al.* (2013) who reported that GA_3 treatment retarded ethylene biosynthesis that caused delay in ripening and ultimately lowered TSS and total sugars accumulation.

Regardless of treatments, titratable acidity of stored fruits significantly decreased with the advancement of storage period (Table 2). At the end of storage, $CaNO_3$ treated fruits retained higher acid content as compared to GA_3 treated or control fruits. Decline in acidity during storage might be due to the metabolic changes in fruits or due to the use of organic acids in respiratory process (Ishaq *et al*., 2009). An increase in sensory quality was noted in $CaNO_3$ and GA_3 treated pear fruits up to 50 days of storage and subsequently a reduction was observed at the end of storage (Table 3). However, control fruits depicted significantly highest sensory quality rating (8.15) as compared to other treatments after 30 days of storage, followed by a sharp decline. By the end of storage, maximum sensory quality rating (7.15) was observed in fruits treated with 3% $CaNO_3$ which may be attributed to minimum PLW and higher fruit firmness, TSS and acid content. The PME activity of $CaNO_3$ and GA_3 treated pear fruits increased up to 50 days of storage followed by a decline. Increase in enzyme activity with increase in storage period might be due to more substrate availability because of starch hydrolysis to sugars. A decrease in PME activity in fruits at later stages of storage might be attributed to the reduced substrate level due to decomposition. After 50 and 70 days of storage, $CaNO_3$ treatments

Table 3: Effect of post-harvest treatments on sensory quality and pectin methyl esterase (PME) activity of pear fruits during cold storage

Treatments	Sensory quality (1-9) Storage period (days)					PME activity (mL of 0.02 N NaOH used) Storage period (days)				
	0	30	50	70	Mean	0	30	50	70	Mean
$CaNO_3$ 2%	7.15	7.41	7.95	6.90	7.35	0.45	1.26	1.65	1.28	1.16
$CaNO_3$ 3%	7.19	7.25	8.75	7.15	7.59	0.48	1.15	1.68	1.31	1.16
$CaNO_3$ 4%	7.15	7.35	7.98	7.00	7.37	0.43	1.23	1.65	1.29	1.15
GA_3 20 ppm	7.13	7.52	7.68	6.45	7.20	0.46	1.38	1.48	1.24	1.14
GA_3 40 ppm	7.15	7.48	7.78	6.52	7.23	0.45	1.45	1.53	1.29	1.18
GA_3 60 ppm	7.17	7.45	7.82	6.55	7.25	0.47	1.48	1.55	1.25	1.19
Control	7.13	8.15	6.65	5.15	6.77	0.46	1.76	1.49	1.19	1.23
Mean	7.15	7.52	7.80	6.53						
$CD_{0.05}$										
Treatment (t)			0.36					0.04		
Storage (s)			0.27					0.03		
s × t			0.73					0.09		

recorded significantly higher PME activity in fruits as compared to control which had minimum PME activity (1.19 ml of 0.02 N NaOH). A similar decrease in PME activity in ber fruits at later stages of storage has been reported by Jawandha *et al.* (2012).

From the above results, it can be concluded that post-harvest treatment of 3% calcium nitrate effectively reduced PLW and maintained fruit firmness, sensory quality, TSS, titratable acidity, total sugars content and pectin methyl esterase activity during 70 days of storage.

REFERENCES

Amerine, M.A., Pangborn, R.M. and Roessler, E.B. 1965. Principles of sensory evaluation of food. pp. 338-339. **In**: *Food and Technology Monographs.* Academic Press, New York, USA.

Bandey, F.A. 1996. *Cold Storage Studies in Pear cv. LeConte.* Ph.D. Dissertation, Punjab Agricultural University, Ludhiana, India.

Hussain, P.R., Dar, M.A., Meena, R.S., Mir, M.A., Shafi, F. and Wani, A.M. 2008. Changes in quality of apple (*Malus domestica*) cultivars due to gamma irradiation and storage conditions. *Journal of Food Science and Technology,* **45**: 444-449.

Ishaq, S., Rathore, H.A., Majeed, S., Awan, S. and Zulfiqar, A.S. 2009. The studies on the physico-chemical and organoleptic characteristics of apricot (*Prunus armeniaca* L.) produced in Rawalakot, Azad Jammu and Kashmir during storage. *Pakistan Journal of Nutrition*, **8**: 856-860.

Islam, M.K., Khan, M.Z.H., Sarkar, M.A.R., Yeasmin, S., Ali, M.K. and Uddin, M.H. 2013. Post-harvest quality of mango (*Mangifera Indica* L.) fruit affected by different levels of gibberellic acid during storage. *Malaysian Journal of Analytical Sciences*, **17**: 499-509.

Jawandha, S.K., Gupta, N. and Randhawa, J.S. 2012. Effect of post-harvest treatments on enzyme activity and quality of cold stored ber fruit. *Notulae Scientia Biologicae,* **4**: 86-89.

Mahadevan, A. and Sridhar, R. 1982. *Methods in Physiological Plant Pathology*. Sivagami Publishers, Madras, India.

Sandhu, A.S., Paul, S. and Dhillon, W.S. 2004. Studies on storage behaviour and shelf-life of semi-soft subtropical pear *cv.* Punjab Beauty. *Acta Horticultureae,* **662**: 385-390.

Sonia, Gill., P.P.S, and Jawandha, S.K. 2016. Effect of gibberellic acid and putrescine on storage life and fruit quality of pear cv. Punjab beauty. *Journal of Environment & Bio-Sciences*, **30**: 83-86.

White, P.J. and Broadley, M.R. 2003. Calcium in plants. *Annals of Botany,* **92**: 487-511.