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Short communication

Effect of calcium chloride and storage period at ambient temperature on physico-chemical characteristics of pear cv. Bartlett

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Pear (*Pyrus communis* L.) can be grown on a wide range of agro-climatic conditions and can resist very low temperature -26°C and as high as 45°C in the growing period. Most of the cultivars introduced from Europe have performed well in Kashmir valley. In J&K production of pear has touched 47,982 m tonnes from an area of 12,547 ha (Anon, 2). The major portion of pear cv. Bartlett has been grown over the maximum area in the valley, as it is a mid-season cultivar and matures 110 to 115 days after full bloom, but due to non-availability of storage facilities, the entire fruit is being sent outside the state and glut in the market the fruit does not get high value. In order to maintain its storage life, quality and consumers acceptability, calcium sprays have been found most effective, as the calcium plays an important role in maintaining the quality of fruits, not because of its positive relationship to physiological disorders, but also because of its other desirable effects, particular in fruit, where it could reduce respiration, delay ripening and increase fruit firmness thereby increasing the storage and shelf-life.

The present investigation was conducted at experimentation station, Division of Pomology, Sher-e- Kashmir University of Agriculture Science and Technology- Kashmir during the two consecutive years (2004 and 2005) Twenty four-year-old bearing trees on seedling stock, uniform in vigour and health were selected for experimentation. The orchard has proper soil and air drainage and faced on the southern aspect. The trees were spaced 6 m x 6 m and received uniform cultural treatments. Calcium chloride salt at three concentrations (0, 0.25, 0.50 & 0.75%) was sprayed on trees as pre-harvest treatments. Two sprays were given at 45 and 60 days before harvest. The foliage and the fruits were completely drenched to a slightly run-off by spraying. The treatments were replicated thrice in a randomized block design. The fruits were harvested at three different dates, *viz.*, 105, 110 and 115 days after bloom (DAFB) and after removing the diseased/ damaged fruits, were analyzed for different physico-chemical characteristics, *viz.*, fruit, size, weight, volume, colour, organoleptic rating, firmness, acidity, total soluble solids, starch rating, sugar and calcium content.

The colour change was determined by visual score (green = 1, greenish yellow = 2, straw yellow = 3 and yellow = 4). Organoleptic rating was done on a 4 pt scale by employing the characteristic of taste, flavour, texture, crispness and juiciness. Flesh firmness was measured with the help of effegi pressure tester plunger diameter 8 mm in kg/cm^2. Acidity was measured in terms of malic acid and total soluble solids by AOAC methods (1). Starch rating was determined in iodine solution by visual 1-4 scores (1, starch present throughout entire surface colored, 2, starch absent from core area, 3, starch absent from core area and vascular bundles, 4, starch present in outer half of cortex). Sugars were determined by standard methods AOAC (1). Calcium content in the fruit was determined using atomic absorption spectrophotometer. The data was analyzed as per standard methods Panse and Sukhatme, (6)

Colour development of the fruits was significantly affected during storage by calcium chloride treatments. Retarded colour development upto 15 days of storage period was observed in calcium treated fruits as compared to untreated ones. In the present study colour development in calcium treated fruits during ambient storage was delayed. These results are in close conformity with the findings of Tirmazi and Wills (10) who reported delayed colour development in mango and pear fruits treated with calcium chloride. Similar results have been reported by Wills and Tirmazi *et al.* (11) who observed that disappearance of green colour in pear cv. Bartlett treated with calcium chloride solution and subsequent storage at 20°C was substantially delayed. The delay in ripening may be due to retarded rate of respiration and ethylene production.

Fruits treated with calcium chloride retained more firmness than untreated fruits during storage. Fruits treated with calcium chloride were firmer than untreated ones. Similar findings have been reported by Farooq and Khajwall (5) in Bartlett pear. Fruit firmness decreased with advancement in storage period which may be due to fast ripening and fruit softening. Calcium treated fruits recorded significantly lower loss in weight

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as compared to untreated fruits during 15 days storage period. Treated fruits exhibited less loss in weight than untreated fruits. The reduction in the extent of weight loss in the treated fruits could possibly be due to retarded rate of transpiration and respiration. These results are in conformity with the finding of Farooq and Khajwall (5), and Bhat *et al.* (3) in Bartlett pear.

Treated fruits exhibited higher organoleptic rating as compared to untreated fruits when stored for 15 days. Fruits treated with calcium chloride recorded higher organoleptic rating than untreated fruits. Wills and Tirmazi (12) noticed that calcium treated avocado fruits on ripening were highly acceptable. The retention of higher organoleptic rating by calcium chloride may possibly be due to retarded rate of fruit ripening and fruit softening. Fruits treated with different concentrations of calcium chloride resulted in decrease in fruit spoilage. significantly less spoilage was recorded in calcium treated fruits as compared to untreated fruits (Table 1). Calcium treated fruits showed significantly lesser extent of rotting which may be due to higher fruit flesh and skin calcium content, which resulted in stronger intracellular organization and rigidified cell walls as reported by Dhillon (4).

Calcium treated fruits recorded comparatively higher percentage of malic acid as compared to untreated fruits stored for 15 days. Fruits treated with calcium chloride recorded significantly less acid content which may be due to slow rate of respiration and fruit ripening as reported by Raese and Drake (7) with Anjou pears. Acidity of pear fruits in the present study decreased significantly with the advancement of storage period. These findings are in agreement with those of Bhat *et al.* (3). Treated fruits exhibited retarded accumulation of soluble solids as compared to untreated fruits during 15 days storage. Fruits treated with calcium chloride showed significantly lesser content of total soluble solids during storage. Decrease in the total soluble solids may be attributed due to retarded rate of fruit ripening and fruit softening. The findings are in line with the reports of Singh *et al.* (9) in peach and Farooq and Khajwall (5) in Bartlett pear.

Calcium treated fruits recorded comparatively lesser starch rating as compared to untreated fruits stored for 15 days. Fruits treated with calcium chloride retained higher starch rating as compared to untreated fruits. The decrease in starch content may be attributed to the conversion of starch to soluble sugars with the progress of time. The retention of higher starch level in treated fruits could possibly be indicative of delay in starch to sugar transformation due to influence of calcium chloride treatment. This is in conformity with the findings of Randhawa (8) in Patharnakh. Starch content in storage decreased which may be due to conversion of starch to sugars. Reducing sugar content of calcium treated fruits showed significantly less

Table 1. Combined effect of calcium chloride treatments and storage period at ambient temperature on physical characteristics of pear cv. Bartlett.

Treatment combination	Colour (score)	Firmness (kg/cm^2)	Weight loss (%)	Organoleptic rating (%)	Spoilage (%)
C0S0	1.02	7.34	0.00	1.73	0.00
C0S1	1.15	6.84	3.96	1.76	6.34
C0S2	1.54	5.08	9.22	1.84	10.85
C0S3	2.04	3.32	13.05	1.93	16.74
C1S0	0.88	7.47	0.00	1.76	0.00
C1S1	1.13	7.10	3.70	1.85	5.42
C1S2	1.63	5.96	8.31	1.91	8.90
C1S3	1.94	4.29	12.33	1.99	15.04
C2S0	0.88	7.72	0.00	1.88	0.00
C2S1	1.19	7.24	3.36	1.94	4.60
C2S2	1.50	6.11	8.08	2.07	7.62
C2S3	2.06	4.92	11.51	2.15	13.76
C3S0	0.81	8.05	0.00	1.93	0.00
C3S1	1.48	7.63	3.11	2.05	4.18
C3S2	1.63	6.53	7.34	2.16	6.76
C3S3	1.85	4.96	10.21	2.38	11.88
$CD_{0.05}$	0.19	0.51	0.04	NS	0.31

Table 2. Combined effect of calcium chloride treatments and storage period at ambient temperature on chemical characteristics of pear cv. Bartlett.

Treatment combination	Acidity (%)	TSS (%)	TSS/acid ratio	Starch rating score	Reduced sugar (%)	Total sugars (%)	Calcium content (%)	
							Peel	Flesh
C0S0	0.312	9.69	23.28	2.97	3.14	3.32	0.063	0.070
C0S1	0.306	9.94	24.30	3.15	3.27	3.58	0.066	0.077
C0S2	0.297	10.04	25.37	3.33	3.63	4.00	0.068	0.078
C0S3	0.290	10.27	26.61	3.55	4.41	4.81	0.070	0.081
C1S0	0.312	9.44	22.70	2.78	3.07	3.25	0.065	0.075
C1S1	0.307	9.63	23.52	2.96	3.24	3.54	0.067	0.079
C1S2	0.297	9.81	24.78	3.15	3.57	3.93	0.070	0.079
C1S3	0.290	10.01	25.86	3.35	4.16	4.59	0.067	0.084
C2S0	0.311	9.06	21.87	2.59	3.00	3.22	0.067	0.078
C2S1	0.305	9.25	22.70	2.78	3.22	3.50	0.069	0.082
C2S2	0.297	9.44	23.87	2.96	3.47	3.81	0.073	0.082
C2S3	0.289	9.61	24.96	3.21	4.11	4.52	0.073	0.088
C3S0	0.310	8.88	21.47	2.40	2.82	3.17	0.070	0.081
C3S1	0.305	9.06	22.29	2.59	3.19	3.45	0.071	0.084
C3S2	0.296	9.25	23.24	2.78	3.43	3.76	0.075	0.084
C3S3	0.288	9.41	24.51	3.06	4.07	4.49	0.076	0.083
$CD_{0.05}$	NS	NS	NS	NS	0.23	0.02	0.001	0.001

reducing sugar content than untreated ones during 15 days storage period.

Fruits treated with higher concentration of calcium chloride recorded significantly less total sugars content as compared to untreated fruits. Fruits treated with calcium chloride showed lesser content of sugars during storage as compared to untreated ones. This may be due to increased level of calcium in the fruits which can retard ripening and senescence process resulting in slower hydrolysis of polysaccharides into monosaccharides. Identical results have been reported by Farooq and Khajwall (5) in Bartlett pear. Significantly higher peel calcium content was recorded in fruits treated with higher concentrations of calcium chloride as compared to untreated ones after 15 days storage.

Fruits treated with 0.50 per cent calcium chloride recorded significantly higher calcium content than other treatments including control during 15 days storage period. (Table 2) Treated fruits recorded higher calcium content than untreated fruits. The higher uptake of calcium resulted with the increased level of calcium chloride in the spray solution. Similar findings have been observed by Bhat *et al.* (3). Farooq and Khajawall (5) also reported in Bartlett pears with 12 per cent calcium chloride dip. Prolongation of storage life of treated fruits can also be attributed to higher calcium content which resulted in higher firmness.

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