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Effect of post-harvest treatment on storage quality in 'Umran' ber fruit

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ABSTRACT

An experiment was conducted to study the effect of post-harvest sprays of $CaCl_2$ (@ 0.5%, 1.0% & 2.0%), $Ca(NO_3)_2$ (@ 0.5%, 1.0% & 2.0%), GA_3 (@ 20, 40 and 60 ppm) and Bavistin (0.1%) on storage quality of 'Umran' ber'. Fruits of uniform size were harvested at physiological maturity and treated with various chemicals. Treated fruits were placed in CFB boxes and placed in cold storage (3-5 °C and 85-95% RH). Stored fruits were evaluated at 10, 20 and 30 days from storage for palatability rating, TSS, acidity, Vitamin C and total sugars. After 30 days from storage, the highest palatability rating was recorded in GA_3 (60 ppm) treated fruits, followed by $CaCl_2$ (2.0%). Both TSS and Total sugars showed a similar trend of increase upto 20 days from storage, followed by a decrease. However, acidity and Vitamin C content of fruits decreased continuously with advancement of storage period. At the end of storage, maximum TSS, total acidity Vitamin C and total sugars were observed in GA_3 (60 ppm) treated fruits, followed by $CaCl_2$ (2.0%). Studies revealed that GA_3 (60 ppm) treated ber fruits maintained very good quality at 20 days of cold storage.

Key words: Ber, GA_3, calcium, post-harvest treatment, cold storage

INTRODUCTION

Ber *(Zizyphus mauritiana* Lamk.) is a hardy fruit crop and its fruits are a good source of Vitamin C and minerals like calcium, phosphorus and iron. It is an ideal fruit for cultivation in the arid and semi-arid zones of northern India, because of its very low irrigation requirement in the hot and dry months of May and June, when it sheds its leaves and enters into a period of dormancy. Due to high economic returns, improved budded varieties of ber are being cultivated on a commercial scale in Punjab, Haryana, Rajasthan and Uttar Pradesh. Ber can thrive well under adverse conditions, viz., salinity, drought and water-logging. However, high post-harvest losses are a major constraint in developing the ber fruit industry in the country. Ber fruits are perishable in nature and cannot be stored for long periods under ambient conditions (Salunkhe and Kadam, 1995). Calcium compounds are known to extend the shelf-life of several fruits by maintaining firmness, minimizing the rate of respiration, protein breakdown and disease incidence (Gupta *et al*, 1980). Growth regulators also increase the post harvest life of fruits by retarding of ripening, senescence, by minimizing the rate of respiration and by reduction in weight loss (Huang, 1974). The ber industry can take a further leap if its post-harvest life is extended without significant deterioration in fruit quality. The present study was, therefore, undertaken to study the effect of post-harvest treatments with various chemical compounds on the quality of ber fruit during cold storage.

MATERIAL AND METHODS

The present study was conducted in the Department of Horticulture, Punjab Agricultural University, Ludhiana during the years 2002 and 2003. Uniform sized fruits of 'Umran' cultivar were harvested at optimum maturity from the marked trees. The fruits were dipped in aqueous solution (at 20°C) of different compounds, viz., as $CaCl_2$ (0.5, 1.0 & 2.0%), $Ca(NO_3)_2$ (0.5, 1.0 & 2.0 %), GA_3 (20, 40 & 60 ppm) and Bavistin (0.1%) for five minutes. Treated fruits were then air dried in shade, packed in Netlon bags (1.0 kg) and placed in CFB boxes (30.0 x 21.5 x 21.5 cm) of 5% perforation with paper lining. Thereafter, these boxes were kept in cold storage (3-5°C and 85-95% RH). The experiment was laid out in completely randomized block design with eleven treatments and three replications. Each replication comprised of one kilogram fruit. Fruit samples were analysed for physico-chemical changes like palatability rating (PR), TSS, acidity, Vitamin C content and total sugars at 10, 20 and 30 days of storage. Palatability

rating (PR) was recorded on the basis of a score card viz., 1-poor; 2-Fair; 3-Good; 4-Very good and 5-Excellent (Dhanrai *et al,* 1980). Total soluble solids (TSS) were determined with the help of hand refractometer from the juice of fruit and the values were corrected at 20°C. Fruit acidity was estimated by titrating the juice against standard 0.1 N sodium hydroxide solution using phenolphthalein as indicator and represented as per cent. Vitamin C content was determined by titrating the juice against 2, 6-dichlorphenol indophenol dye solution to a light pink colour, which persisted for 15 seconds. Results were expressed as mg/100 g of fruit flesh. Total sugars were estimated by titrating boiling Fehling Solution (5 ml A + 5 ml B) against aliquot using methylene blue as the indicator (A.O.A.C., 1980).

RESULTS AND DISCUSSION

Palatability rating (PR) of fruits decreased significantly with advancement of storage period regardless of the post harvest treatment (Table 1). At the end of storage, fruits treated with GA_3 (60 ppm) showed maximum PR (3.16 & 3.25). Prolongation of fruit life due to growth regulators is probably due to effectiveness of these chemicals in retardation of ripening and senescence and reduction in weight loss (Huang, 1974). Likewise, various calcium treatments significantly increased PR as compared to control. Increase in calcium content of the fruits has been associated with reduced softening (Haggag, 1987), decreased incidence of physiological disorders and improved storage life (Raese, 1986). Similar results were also reported by Chahal and Bal (2003) in ber fruits. TSS content of fruits increased upto 20 days of storage in all the treatments, except the control, which recorded increase in TSS content only upto 10 days of storage (Table 2). But, at 30 days of storage, decrease in TSS content was noticed in all the treatments. Jawanda *et al* (1980) also reported inconsistent trend in TSS of ber fruits during cold storage. Among the different treatments, GA3 (60 ppm) recorded the maximum TSS at the end of storage, closely followed by $CaCl_2$ (2.0%) treatment. This might be due to reduction in metabolic activities like respiration and senescence by GA_3 (60 ppm) and $CaCl_2$ (2.0%) treatments. During the course of investigation, there was an initial rise in TSS content of fruits till it reached the peak, followed by a gradual decline after 30 days of storage. The initial increase in TSS may be due to hydrolysis of starch into mono-and di-saccharides, and, on complete hydrolysis of starch, no further increase occurred. Subsequently, a decline was observed because of utilization of the primary substrate for respiration (Wills *et al,* 1980).

Fruit acidity showed a general decline in all the treatments as storage period progressed (Table 3). Such a decrease in acidity might be attributed to conversion of acids to sugars and then utilization in the respiration process (Pool *et al,* 1972). Sandbhor and Desai (1991) also reported a gradual decrease of acid content in ber fruit during storage. After 30 days of cold storage, lowest acidity was recorded

Table 1. Effect of post-harvest treatment on palatability rating in ber fruits during cold storage

Treatment	Palatability rating							
	2002				2003			
	Days after storage				Days after storage			
	10	20	30	Mean	10	20	30	Mean
$CaCl_2$ 0.5%	4.58	3.25	2.30	3.38	4.40	3.15	2.40	3.32
$CaCl_2$ 1.0%	4.66	3.30	2.40	3.45	4.50	3.41	2.50	3.47
$CaCl_2$ 2.0%	4.80	3.70	3.00	3.83	4.80	3.60	3.10	3.83
$Ca(NO_3)_2$ 0.5%	4.41	3.00	2.15	3.19	4.30	3.00	2.20	3.17
$Ca(NO_3)_2$ 1.0%	4.60	3.15	2.20	3.31	4.38	3.00	2.33	3.24
$Ca(NO_3)_2$ 2.0%	4.50	3.40	2.50	3.46	4.58	3.50	2.75	3.61
GA_3 20 ppm	4.60	3.20	2.30	3.37	4.50	3.33	2.50	3.44
GA_3 40 ppm	4.75	3.50	2.75	3.67	4.70	3.60	2.85	3.72
GA_3 60 ppm	4.80	4.00	3.16	3.97	4.83	3.75	3.25	3.94
Bavistin 0.1%	4.00	3.00	2.00	3.00	4.25	3.10	2.00	3.12
Control (untreated)	3.75	2.50	1.60	2.62	3.83	2.60	1.62	2.68
Mean	4.50	3.27	2.40		4.46	3.28	2.50	
CD *(P=0.05)*								
Treatments (A)	=	0.213				0.183		
Storage days (B)	=	0.111				0.196		
Interaction (A x B)	=	0.302				0.210		

Table 2. Effect of post-harvest treatment on total soluble solids in ber fruits during cold storage

Treatment	TSS%							
	2002				2003			
	Days after storage				Days after storage			
	10	20	30	Mean	10	20	30	Mean
$CaCl_2$ 0.5%	13.66	14.40	12.50	13.52	13.53	14.30	12.60	13.48
$CaCl_2$ 1.0%	13.53	14.20	12.66	13.46	13.40	14.20	12.70	13.43
$CaCl_2$ 2.0%	13.46	13.80	12.86	13.37	13.35	13.80	12.94	13.36
$Ca(NO_3)_2$ 0.5%	13.80	14.80	12.30	13.63	13.60	14.40	12.46	13.49
$Ca(NO_3)_2$ 1.0%	13.70	14.40	12.45	13.52	13.60	14.20	12.60	13.46
$Ca(NO_3)_2$ 2.0%	13.60	14.00	12.70	13.43	13.50	14.00	12.80	13.43
GA_3 20 ppm	13.60	14.40	12.60	13.53	13.60	14.20	12.70	13.50
GA_3 40 ppm	13.40	13.93	12.80	13.38	13.42	13.80	12.85	13.36
GA_3 60 ppm	13.40	13.70	13.00	13.37	13.20	13.73	13.13	13.35
Bavistin 0.1%	13.66	14.60	12.33	13.53	13.70	14.40	12.40	13.50
Control (untreated)	14.80	13.80	12.10	13.57	14.80	13.86	12.00	13.55
Mean	13.69	14.18	12.57		13.61	14.08	12.65	
CD *(P=0.05)*			Base value = 13.20				Base value = 13.10	
Treatments (A)	=	0.072				0.008		
Storage days (B)	=	0.088				0.010		
Interaction (A x B)	=	0.029				0.033		

Table 3. Effect of post-harvest treatment on acidity in ber fruits during cold storage

Treatment	Acidity (%)							
	2002				2003			
	Days after storage				Days after storage			
	10	20	30	Mean	10	20	30	Mean
$CaCl_2$ 0.5%	0.154	0.144	0.128	0.142	0.157	0.143	0.132	0.144
$CaCl_2$ 1.0%	0.157	0.144	0.130	0.143	0.160	0.150	0.137	0.149
$CaCl_2$ 2.0%	0.164	0.152	0.140	0.152	0.170	0.156	0.142	0.156
$Ca(NO_3)_2$ 0.5%	0.152	0.139	0.122	0.137	0.155	0.140	0.130	0.142
$Ca(NO_3)_2$ 1.0%	0.157	0.140	0.126	0.141	0.160	0.150	0.134	0.148
$Ca(NO_3)_2$ 2.0%	0.164	0.146	0.134	0.148	0.164	0.148	0.138	0.150
GA_3 20 ppm	0.160	0.148	0.136	0.148	0.164	0.152	0.138	0.151
GA_3 40 ppm	0.167	0.150	0.138	0.151	0.174	0.152	0.140	0.155
GA_3 60 ppm	0.170	0.156	0.142	0.156	0.174	0.159	0.148	0.160
Bavistin 0.1%	0.152	0.140	0.124	0.138	0.157	0.146	0.132	0.145
Control (untreated)	0.140	0.132	0.120	0.130	0.150	0.138	0.118	0.135
Mean	0.157	0.144	0.131		0.162	0.148	0.135	
CD *(P=0.05)*			Base value = 0.173			Base = 0.176		
Treatments (A)	=	0.0034				0.0032		
Storage days (B)	=	0.0018				0.0017		
Interaction (A x B)	=	NS				NS		

in untreated fruits, whereas highest acidity was observed with GA_3 (60 ppm) followed by $CaCl_2$ (2.0%) treatment. This might be due to low respiration rate in GA_3 (60 ppm) and $CaCl_2$ (2.0%) treatments. Data pertaining to Vitamin C content in the fruit are presented in Table 4. Significant decrease in Vitamin C content was noted with advancement of storage period in all the treatments. These findings were in accordance with the results of Bal *et al* (1978) who reported a decrease in Vitamin C content with prolongation of storage period. Reduction in Vitamin C content might be attributed to its oxidation in the presence of molecular oxygen by ascorbic acid oxidase (Mapson, 1970; Tarkase and Desai, 1989). At the end of storage, minimum Vitamin C content was found in Control fruits, whereas, it was maximum in GA_3 (60 ppm) treated fruits, followed by $CaCl_2$ (2.0%) treatment, which may be a result of low respiration transpiration rates and delayed senescence (Huang,1974; Faust and Shear, 1972).

Total sugars showed an increasing trend up to 20 days of storage in all the treatments except in control, but decreased after 30 days of storage. Similar results were also reported by Jayachandran *et al* (2005) in gauva fruits. Stahl and Camp (1971) reported certain cell wall materials such

Table 4. Effect of post-harvest treatment on Vitamin C content in ber fruits during cold storage

Treatment	Vitamin C (mg/100 g fruit flesh)							
	2002				2003			
	Days after storage			Mean	Days after storage			Mean
	10	20	30		10	20	30	
$CaCl_2$ 0.5%	82.76	62.80	53.68	66.41	83.25	63.45	55.03	67.24
$CaCl_2$ 1.0%	84.32	67.08	57.63	69.67	87.20	67.12	57.83	70.72
$CaCl_2$ 2.0%	90.87	71.42	60.88	74.39	92.86	71.79	63.92	76.19
$Ca(NO_3)_2$ 0.5%	82.80	60.40	52.29	65.16	82.40	60.93	54.49	65.94
$Ca(NO_3)_2$ 1.0%	85.98	63.84	55.62	68.48	84.80	66.41	56.34	69.18
$Ca(NO_3)_2$ 2.0%	86.72	65.27	58.26	70.08	88.32	67.44	59.74	71.83
GA_3 20 ppm	88.44	67.35	56.82	70.87	90.40	68.36	57.62	72.13
GA_3 40 ppm	91.59	70.23	59.83	73.88	93.82	72.62	62.03	76.16
GA_3 60 ppm	95.10	73.48	62.39	76.99	96.56	79.46	64.48	80.16
Bavistin 0.1%	80.82	61.13	55.10	65.68	82.34	62.10	52.80	65.75
Control (untreated)	77.73	56.02	50.69	61.48	79.20	57.26	49.87	62.11
Mean	86.10	65.36	56.65		87.38	66.99	57.65	
CD *(P=0.05)*			Base value = 96.79				Base value = 98.93	
Treatments (A)	=	1.224				1.018		
Storage days (B)	=	0.639				0.532		
Interaction (A x B)	=	2.121				1.764		

Table 5. Effect of post-harvest treatment on total sugars in ber fruits during cold storage

Treatment	Total sugars (%)							
	2002				2003			
	Days after storage			Mean	Days after storage			Mean
	10	20	30		10	20	30	
$CaCl_2$ 0.5%	10.08	10.38	9.00	9.82	10.01	10.30	9.02	9.78
$CaCl_2$ 1.0%	9.92	10.27	9.02	9.74	9.89	10.26	9.10	9.75
$CaCl_2$ 2.0%	9.84	10.00	9.22	9.69	9.70	10.07	9.29	9.68
$Ca(NO_3)_2$ 0.5%	10.16	10.67	8.80	9.87	10.10	10.35	8.93	9.79
$Ca(NO_3)_2$ 1.0%	10.10	10.37	8.92	9.80	10.10	10.26	9.02	9.79
$Ca(NO_3)_2$ 2.0%	9.90	10.17	9.09	9.72	9.90	10.17	9.16	9.74
GA_3 20 ppm	9.90	10.38	9.02	9.76	9.92	10.28	9.10	9.76
GA_3 40 ppm	9.82	10.10	9.18	9.70	9.77	10.10	9.20	9.69
GA_3 60 ppm	9.78	9.90	9.30	9.66	9.68	9.92	9.40	9.66
Bavistin 0.1%	10.10	10.65	8.82	9.86	10.14	10.37	8.90	9.80
Control (untreated)	10.69	10.15	8.73	9.86	10.60	9.90	8.84	9.78
Mean	10.02	10.27	9.01		9.98	10.18	9.08	
CD *(P=0.05)*			Base value= 9.71				Base value = 9.60	
Treatments (A)	=	0.061				0.059		
Storage days (B)	=	0.092				0.072		
Interaction (A x B)	=	0.030				0.040		

as pectin and hemicellulose to be converted into reducing substances during prolonged storage. At the end of the storage, maximum total sugars content were recorded in GA_3 (60 ppm) and $CaCl_2$ (2.0%) treated fruits, whereas untreated fruits registered minimum total sugars content (Table 5). It might be due to low respiration rate and delayed senescence in GA_3 and $CaCl_2$ (2.0%) treated fruits. Gupta *et al* (1984) stated that calcium compounds significantly thickened middle lamella of the fruit cells owing to increased deposition of calcium pectate, thereby maintaining the cell wall and cell wall material.

REFERENCES

A.O.A.C. 1980. Official methods of analysis of analytical chemists. Association of the Official Analytical Chemists, Washington, D.C.

Bal, J. S. Singh, P. and Singh, R. 1978. Preliminary observations on the storage behaviour of ber at room and refrigerated temperature. *J. Res. Punjab Agri. Univ., Ludhiana* **25:** 396-99.

Chahal, S. and Bal, J. S. 2003. Effect of post-harvest treatments and packaging on shelf-life of 'Umran' ber at cool temperature. *J. Res. Punjab. Agri. Univ.,* **40 :** 363-370.

Dhanraj, S., Ananihakrishna, S. M. and Govindrajan, V. S. 1980. Apple quality: development of descriptive quality profile for objective sensory evaluation. *J. Food Qual.* **4** : 83-100.

Faust, M. and Shear, C. B. 1972. The effect of calcium on respiration of apples. *J. Amer. Soc. Hortl. Sci.,* **97** : 437-439.

Gupta, O. P. Jindal, P. C and Singh, B. P. 1980. Effect of pre-harvest spray of calcium nitrate on the storage behaviour of grapes cv. Perlette. *J. Res. Haryana Agri. Univ.,* **10**: 204-206.

Gupta, O. P. Singh, B. P. Singh, S. P. and Chauhan, K. S. 1984. Effect of calcium compounds as pre-harvest spray on the shelf life of peach cv. Sharbati. *Punjab Hort. J.,* **24** : 105-110.

Haggag, M. N. 1987. Effects of pre-harvest and post-harvest calcium treatments on storage behaviour of LeConte pears. *Alexandra J. Agri. Res.,* **32** : 175-188.

Huang, C. C. 1974. Maintaining freshness of pineapple fruits for export. *Taiwan Agril. Quarterly,* **10**: 103-11.

Jayachandran, K. S., Srihari, D. and Reddy, Y. N. 2005. Pre-harvest sprays of different sources of calcium to improve the shelf-life of guava. *Ind. J. Hortl. Sci.,* **62**: 68-70.

Jawanda, J. S., Bal, J. S., Josan, J. S. and Mann, S. S. 1980. Studies on storage of ber fruit II. Cool temperature. *Punjab Hort. J.,* **20** : 56-61.

Mapson, L.W. 1970. Vitamins in fruits: Stability of L-ascorbic acid. **In:** Biochemistry of Fruits and their products. Vol. I (Ed., A.C. Hulme). Academic Press, London 376-377.

Pool, K. M. Weaver, R. J. and Kliewer, K. M. 1972. The effect of growth regulators on changes in fruits of Thompson Seedless during cold storage. *J. Amer. Soc. Hortl. Sci.,* **97**: 67-70.

Rasese, J. T. 1986. Nitrogen and calcium important in determining yield, fruit quality and disorders of 'Anjou' pears. In. *Proc. Pac. Northwest Tree Fruit Short Course.* pp. 155-168.

Salunkhe, D. K. and Kadam, S. S. 1995. *Handbook of Fruit Science and Technology* pp 387. Marcel Dekker Inc., New York.

Sandbhor, D. R. and Desai, U. T. 1991. Influence of post harvest treatment on the shelf life of ber *(Zizyphus mauritiana* Lamk.) cv. Umran. *Mah. J. Hort.,* **5**: 24-28.

Stahl, A. C. and Camp, A. F. 1971. Citrus fruits. *In The Biochemistry of Fruits and their Products* (Ed., Hulme A C). **2**: 107-169.

Tarkase, E. G. and Desai, U. T. 1989. Effects of packaging and chemicals on storage of orange cv. Mosambi, *J. Mah. Agri. Univ.,* **14**: 10-13.

Wills, R. B. H. Babmbridge, P. A. and Scott, K. J. 1980. Use of flesh firmness and their objectives tests to determine the consumer acceptability of Delicious apple. *Aust. J. Agri. Anim. Husb.,* **20**: 252-256.

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