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RESEARCH ARTICLE

Impact of post harvest treatments on shelf life of Kinnow mandarin

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Abstract

Kinnow fruits were subjected to post harvest treatments of Ca NO_3 (0.5 % and 1.0 %), $CaCl_2$ (1 % and 2 %) and bavistin (500 ppm and 1000 ppm). The fruits were stored under ambient and cold storage conditions to compare the efficacy of different treatments and storage conditions in retaining fruit quality during prolonged storage. Results indicated that fruits treated with bavistin 500 ppm could be kept up to 45 days in cold storage with higher retention of fruit quality. Data on shelf life, PLW, juice content, TSS, acidity, Vitamin C indicated that the cold storage might be an ideal storage facility for maintaining market acceptability of Kinnow.

Introduction

The cultivation of Kinnow mandarin has assumed a considerable significance during the recent years in India and it is grown in Punjab, Haryana, Himachal Pradesh and some parts of Rajasthan. The excellent quality fruits are generally harvested during the peak winter months but the demand picks up a little later. Kinnow has a poor storage quality and can not be transported to distant markets (Sandhu et al., 1983). However, the keeping quality of Kinnow can be extended through proper storage (Cohen et al 1990). Post harvest dipping treatment increases the shelf life of the fruits by retaining their firmness and control of the decaying organism (Ahmead et al., 2005).

Calcium salts are known to be involved in a number of physiological processes concerning membrane structure, function and enzymatic activity (Chahal and Bal 2012). Post harvest calcium treatment represent safe and effective method for improving quality and extending storage life of fresh fruits. Calcium delays the process of ripening and softening by altering intracellular and extracellular processes. Calcium also increases storage life of fruits by decreasing probability of infection by post harvest diseases and internal breakdown. Bavistin treatment followed by packing of fruits in LDPE bags has been effective in retaining fruit quality during storage. Pal et al (1997) reported that fruits treated with bavistin in combination with semperfresh could be kept up to 45 days in cold storage against 15 days at room temperature.

Keeping these factors in account, freshly harvested Kinnow fruits were treated with different post harvest dipping treatments to evaluate their performance under ambient and cold storage conditions.

Material and Methods

Kinnow fruits were harvested at proper maturity from the orchard of PAU, Regional Research Station, Abohar during the years 2011 and 2012 and brought immediately to the laboratory for storage. Uniform and healthy fruits were selected, washed thoroughly and allowed to dry. After drying they were treated with $CaNO_3$ (0.5 % and 1.0 %), $CaCl_2$ (1 % and 2 %) and bavistin (500 ppm and 1000 ppm). Untreated fruits were kept as control. These fruits were packed in CFB boxes and stored at ambient (20-30 ^oC, 35-40 % RH) and cold storage (3-4 ^oC, 85-90 % RH) conditions. These treatments were replicated three times and each replication consisted of 10 Kg fruits. During storage the fruits were analyzed at fortnightly interval at two stages under ambient and at three stages

under cold storage conditions. The data were analyzed by using the factorial in completely randomized design (Panse and Sukhamate, 1978).

Physiological Loss in weight(PLW) : The PLW was expressed as per cent of initial weight on each sampling date.

Juice Percentage : The extracted juice was expressed in percentage weight basis per unit weight of the fruit.

TSS : The total soluble solids were determined with hand refractometer in terms of brix (^{o}Bx).

Acidity and Vitamin C : The acidity of juice was determined in terms of percent anhydrous citric acid by method of AOAC (2000), whereas the Vitamin C content of juice was determined in terms of ascorbic acid (mg/ 100 ml juice) by visual titration method with 2,6 dichlorophenol indophenol dye.

Shelf Life : The shelf life of fruits was determined by judging the un marketability parameters viz., shriveling and softening, which were mainly due to physiological loss in weight. Ten per cent PLW was considered as an index of end point of shelf life in fruits.

Results and Discussion

PLW and Rotting: It is evident from the data presented in Table 1 that there was a sharp increase in PLW of fruits stored at room temperature, whereas the increase in PLW was found to be slow in fruits stored in cold storage under all the treatments. Application of different chemicals reduced loss in weight of Kinnow fruits during the storage period. However, bavistin (500 ppm) exhibited greater influence in minimizing the physiological loss in weight. The maximum physiological loss in weight (11.63 %) was observed in control, whereas, it was minimum (4.07 %) in the bavistin (500 ppm) in cold storage 45 days after initiation of experiment. The same observation was also recorded in ambient conditions with 500 ppm bavistin, followed by 1000 ppm bavistin. The lower PLW with bavistin (500 ppm) treated fruits was probably due to reduced rate of transpiration and respiration. These findings substantiate the earlier reports on the aspect by Bramachari et al (1999) in litchi and Gupta and Mehta (1987) in ber.

The results presented in Table 2 revealed that the rotting of fruits increased with the advent of storage period in both the storage environments. In ambient storage, maximum spoilage (33.33 %) was recorded in untreated fruits as compared to other treatments after 30 days of storage. In cold storage conditions, non significant effect of treatments were recorded on the rotting after 45 days of storage. However in Calcium chloride (2.0 %) and bavistin (1000 ppm) slightly higher rotting was observed as compared to control under cold storage conditions. This might be due to some internal injury within the fruits during storage which might have occurred in the fruit during harvesting and transportation.

Juice Percentage : The data presented in Table 3 indicates that the juice content of Kinnow fruits decreased with increase in storage period under both the conditions of storage irrespective of the treatments. However, the effect of treatments on juice recovery irrespective of storage conditions was found to be non – significant.

TSS : The data pertaining to the influence of different post harvest treatments and storage conditions on TSS is presented in Table 4. The initial rise in TSS of fruit and its decline later was observed under both the conditions of storage regardless of the post harvest treatments. Increase in TSS during storage may be due to breakdown of complex polymers into simpler substances by hydrolytic enzymes which might further be metabolized during respiration and thus the level of TSS decreased during subsequent storage (Garg and Ram 1974). The rate of increase of TSS was faster at room temperature than in cold storage. Similar findings have been reported by Waskar et al (1999) in Pomegranate in cold storage. No significant effect on TSS content of Kinnow fruits up to 45 days of storage in cold storage conditions and up to 30 days under ambient conditions were observed under different treatments. However, mean TSS was maximum during ambient storage (13.23 %) and cold storage (12.74 %) with $CaCl_2$ (1 %) and bavistin (500 ppm) respectively.

Acidity : Table 5 reveals that with an increase in the storage duration, the acidity in fruit juice among the treatments was found to vary non significantly in both ambient and cold storage conditions. The reduction in the acidity of Kinnow fruit juice during storage has also been noticed earlier by Thakur et al (2002) and this might be due to utilization of acids by the respiratory process. The decline in acidity was found to be faster at room temperature as compared to cold storage temperature. This could be associated with the higher rates of respiration since acid forms the necessary respiratory substrate for this catabolic process in fruits. Similar observations were reported by Koksal (1989) in pomegranate and by Thakur et al (2002) in Kinnow under different storage conditions.

Vitamin C : The retention of ascorbic acid was found to be better in fruits stored in cold storage conditions as compared to those stored at room temperature. The ascorbic acid content decreased progressively with the advancement of storage time irrespective or pretreatment and storage condition. This decline is due to the oxidation of ascorbic acid by enzymes and various treatments applied retarded the activity of the enzymes during storage (Singh and Chauhan, 1993). Similar results have been obtained in litchi by Bramachari et al., 1999. However, mean

maximum ascorbic acid content was observed with $CaCl_2$ (2 %) under ambient storage (23.94 mg/100 ml juice) and with Calcium nitrate (0.5 %) under cold storage conditiond (23.42 mg/100 ml juice). Calcium probably retards the process of oxidation and hence slows down the rate of conversion of ascorbic acid into dehydro ascorbic acid. Higher retention of ascorbic acid due to calcium treatment has been reported in guava (Singh et al., 1981)

Shelf life : It is evident from Table 7 that the shelf life of fruits stored in cold storage conditions was better than that stored at room temperature. The shelf life of the fruits treated with bavistin (500 ppm) could be extended up to 37 days under room temperature, whereas, it could be extended up to 110 day in cold storage conditions.

The availability period of Kinnow fruit can be extended by providing proper storage conditions to the fruit. Post harvest dip treatment in bavistin (500 ppm) followed by storage in cold storage is an effective method in retaining quality of Kinnow fruits. The present study clearly indicates that the cold storage could significantly contribute towards the retention of post harvest quality even more than two months. This can help the Kinnow growers largely for the domestic as well as export marketing of the fruit.

Table 1. Effect of different treatments on PLW (%) of Kinnow fruit in ambient and cold storage conditions

Treatment	Conc.	Storage Interval in days						
		15	30	Mean	15	30	45	Mean
Control	--	7.21	15.88	11.55	3.63	8.79	11.63	8.01
$CaNO_3$	0.5 %	5.90	17.80	11.85	3.32	7.96	11.45	7.54
$CaNO_3$	1.0 %	3.46	10.18	06.83	1.78	5.01	7.96	4.92
$CaCl_2$	1.0 %	4.60	10.40	07.50	2.02	5.30	7.42	4.91
$CaCl_2$	2.0 %	2.87	9.31	06.09	2.02	4.50	6.41	4.31
Bavistin	500 ppm	2.97	8.16	05.57	2.08	3.43	4.07	3.19
Bavistin	1000 ppm	2.73	8.64	05.69	1.48	4.07	6.62	4.05
Mean	--	4.25	11.48	--	2.33	5.61	7.94	--
CD (0.05)	T			1.21	T			0.83
	I			0.79	I			0.55
	TxI			2.09	TxI			1.44

T : Treatment
I : Storage Interval

Table 2. Effect of different treatments on rotting (%) of Kinnow fruit in ambient and cold storage conditions

Treatment	Conc.	Storage Interval in days						
		15	30	Mean	15	30	45	Mean
Control	--	21.22	33.33	27.21	0.00	2.22	5.55	3.88
$CaNO_3$	0.5 %	12.22	25.55	18.89	0.00	1.11	3.33	2.22
$CaNO_3$	1.0 %	19.99	31.11	25.55	0.00	1.11	3.33	3.33
$CaCl_2$	1.0 %	13.33	22.21	17.77	0.00	1.11	6.66	6.66
$CaCl_2$	2.0 %	16.66	24.44	20.55	0.00	1.11	4.44	4.44
Bavistin	500 ppm	26.66	35.55	31.10	0.00	1.11	3.33	3.33
Bavistin	1000 ppm	12.22	17.78	14.99	0.00	4.44	7.77	7.77
Mean	--	17.48	27.14	--	0.00	1.74	4.92	--
CD (0.05)	T			7.60	T			NS
	I			4.06	I			1.97
	TxI			NS	TxI			NS

T : Treatment
I : Storage Interval

Table 3. Effect of different treatments on Juice (%) of Kinnow fruit in ambient and cold storage conditions

Treatment	Conc.	Storage Interval in days						
		15	30	Mean	15	30	45	Mean
Control	--	45.13	43.95	44.54	48.91	42.22	39.56	43.56
$CaNO_3$	0.5 %	49.08	42.34	45.71	49.09	43.88	41.84	44.95
$CaNO_3$	1.0 %	48.11	45.10	46.60	49.22	44.74	43.53	45.83
$CaCl_2$	1.0 %	49.12	46.49	47.81	48.06	43.09	39.48	43.54
$CaCl_2$	2.0 %	47.99	45.82	46.91	48.12	47.52	42.70	46.11
Bavistin	500 ppm	49.09	47.05	48.07	49.22	44.24	41.84	45.10
Bavistin	1000 ppm	46.67	46.15	46.41	47.46	46.24	43.56	45.75
Mean	--	47.88	45.27	--	48.58	44.56	41.79	--
CD (0.05)	T			NS	T			NS
	I			NS	I			2.76
	TxI			NS	TxI			NS

T : Treatment
I : Storage Interval

Table 4. Effect of different treatments on TSS (%) of Kinnow fruit in ambient and cold storage conditions

Treatment	Conc.	Storage Interval in days						
		15	30	Mean	15	30	45	Mean
Control	--	12.20	12.53	12.37	12.73	13.06	12.06	12.38
$CaNO_3$	0.5 %	13.00	12.40	12.70	12.73	13.00	12.0	12.71
$CaNO_3$	1.0 %	12.27	12.13	12.20	12.63	13.00	12.46	12.69
$CaCl_2$	1.0 %	13.46	13.00	13.23	12.20	13.26	12.26	12.57
$CaCl_2$	2.0 %	12.60	11.00	11.80	12.93	13.20	11.53	12.55
Bavistin	500 ppm	12.86	12.20	12.53	13.13	13.33	11.76	12.74
Bavistin	1000 ppm	12.73	12.46	12.60	12.60	13.13	11.93	12.55
Mean	--	12.73	12.25	--	12.60	13.14	12.06	--
CD (0.05)	T			NS	T			NS
	I			NS	I			0.35
	TxI			1.14	TxI			NS

T : Treatment
I : Storage Interval

Table 5. Effect of different treatments on Acidity (%) of Kinnow fruit in ambient and cold storage conditions

Treatment	Conc.	Storage Interval in days						
		15	30	Mean	15	30	45	Mean
Control	--	0.58	0.47	0.53	0.60	0.49	0.47	0.52

$CaNO_3$	0.5 %	0.66	0.42	0.54	0.68	0.50	0.45	0.54
$CaNO_3$	1.0 %	0.55	0.51	0.53	0.59	0.51	0.49	0.53
$CaCl_2$	1.0 %	0.62	0.46	0.54	0.58	0.51	0.48	0.54
$CaCl_2$	2.0 %	0.59	0.55	0.57	0.59	0.57	0.41	0.57
Bavistin	500 ppm	0.52	0.43	0.48	0.59	0.49	0.46	0.48
Bavistin	1000 ppm	0.52	0.45	0.49	0.56	0.49	0.43	0.49
Meam	--	0.58	0.47	--	0.60	0.51	0.46	--
CD (0.05)	T			NS	T			NS
	I			0.05	I			0.05
	TxI			NS	TxI			NS

T : Treatment
I : Storage Interval

Table 6. Effect of different treatments on ascorbic acid (mg/100 ml juice) of Kinnow fruit in ambient and cold storage conditions

Treatment	Conc.	Storage Interval in days						
		15	30	Mean	15	30	45	Mean
Control	--	24.26	21.73	22.99	25.21	23.51	17.94	22.22
$CaNO_3$	0.5 %	25.64	21.11	23.38	27.77	23.91	18.58	23.42
$CaNO_3$	1.0 %	21.57	20.18	20.88	26.71	26.39	17.07	23.39
$CaCl_2$	1.0 %	25.42	17.99	21.71	24.78	23.82	16.87	21.82
$CaCl_2$	2.0 %	25.85	22.04	23.94	25.85	23.91	15.38	21.71
Bavistin	500 ppm	25.52	18.94	22.23	25.55	24.53	19.46	23.18
Bavistin	1000 ppm	22.43	18.63	20.53	22.64	22.05	16.66	20.45
Mean	--	24.38	20.08	--	25.50	24.10	17.42	--
CD (0.05)	T			2.04	T			1.47
	I			1.09	I			0.96
	TxI			2.89	TxI			2.55

T : Treatment
I : Storage Interval

Table 7. Effect of different treatments on shelf life (days) of Kinnow fruit in ambient and cold storage conditions

Treatment	Conc.	Shelf Life (Days)	
		Ambient Storage	Cold Storage
Control	--	20	39
$CaNO_3$	0.5 %	20	39
$CaNO_3$	1.0 %	30	57
$CaCl_2$	1.0 %	32	68
$CaCl_2$	2.0 %	30	70
Bavistin	500 ppm	37	110
Bavistin	1000 ppm	35	61

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