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RESEARCH PAPER

Beneficial effects of kinetin on shelf life of kinnow mandarin

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Abstract : The present investigations were undertaken to extend the shelf life of Kinnow mandarin without affecting the fruit quality at Regional Research Station, Abohar. The harvested fruits were treated with different concentrations of kinetin (15 and 20 ppm). The treated fruits were stored under cold storage (4°C, 90-95 % RH) and ambient conditions (6-21^0 C, 51-85 % RH) after packaging in CFB boxes (10 kg). The physiological loss in weight, rotting, juice, total soluble solids, vitamin C content were recorded at different times of interval of the fruits stored under different conditions. From the data it has been observed that the minimum physiological loss in weight and rotting was recorded with the application of the growth regulator as compared to control under both the conditions. The mean physiological loss in weight (5.02 %) and rotting (6.66 %) were observed to be minimum up to 60 days with the post harvest application of kinetin (20 ppm) , while these were minimum with the same treatment when stored up to 28 days under ambient conditions. The maximum retention of TSS, vitamin C and juice content was observed with the post harvest application of kinetin (20 ppm), while acidity decreased under the cold storage and ambient conditions. Therefore, the shelf life of Kinnow fruits can be extended up to 28 days and 60 days with the post harvest application of kinetin (20 ppm) under ambient and cold storage conditions, respectively without affecting the fruit quality of kinnow mandarin.

Key Words : Kinetin, Shelf life, Kinnow

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INTRODUCTION

Kinnow (*Citrus reticulate* L *x Citrus deliciosa*) is a hybrid grown in Northern India. The excellent quality fruits of kinnow are harvested during the peak winter season in Northern India. However, the demand this fruit picks up with the advent of change of weather. Hence, there is need to extend the availability of kinnow in the market by enhancing its shelf life. The shelf life of kinnow can be extended through proper storage conditions. Under common storage conditions, the kinnow fruits lose their fresh appearance and market value due to post harvest diseases and physiological disorders. Several efforts have been made to increase the shelf life of kinnow, among which post harvest dipping treatment is one which increases the shelf life of fruits by keeping them firm and controlling the decaying organism. Thakur *et al.* (2002) reported that the fruits packed in LDPE bags and stored under ambient conditions remained in the marketable condition up to 8 weeks, whereas, fruits from the cold storage were retained in marketable condition up to 10 weeks. Bavistin treatment followed by packing of fruits in LDPE bags was effective in retaining fruit quality during storage. Beneficial effects of carbendazim and calcium nitrate in kinnow storage have also been reported by Singh and Sharma (2011). However, the environmental consciousness among scientists and general public has drawn attention towards safe use of chemicals on food stuffs. There is need to explore the possibility of using ecofriendly and minimum risk agents for extending the storage period of kinnow fruits safely. The plant growth regulator kinetin arrests the metabolic breakdown deterioration caused by biochemical activities in the fruits. The kinetins act through reduction of polygalactouranose, polymethylesterase and cellulose enzymes in the stored kinnow fruits. Keeping in view these afore mentioned facts, studies were carried out to observe the effects of kinetins on the shelf life of kinnow.

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MATERIAL AND METHODS

Kinnow fruits were harvested at proper maturity from the orchard 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 kinetin (15 and 20 ppm). The untreated fruits were kept as control. These fruits were packed in CFB boxes and stored at ambient (20-30° C, 35-40 % RH) and cold storage (3-4° C, 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. The PLW was determined by periodical weighing of fruits and the weight loss was expressed in per cent with respect to storage time and pre harvest treatments. The rotting per cent was calculated by counting the number of rotten fruits at each stage. The extracted juice was expressed in percentage weight basis per unit weight of the fruit. The total soluble solids were determined with hand refractometer in terms of brix (°B). The acidity of juice was determined in terms of per cent 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 dichlrophenol indophenols dye.

RESULTS AND DISCUSSION

The results of the present study have been presented and discussed under the following headings:

Physiological loss in weight and rotting per cent :

It is evident from the data presented in Table 1 and 2 that PLW and rotting % of fruits increased continuously with the advancement of storage period irrespective of storage conditions or the treatments. However, the increase in PLW

Table 1: Effect of kinetin on physico – chemical characteristics of Kinnow fruits at different intervals under ambient conditions

Parameters	Treatments	Storage period		
		Stage I (14 D)	Stage II (28 D)	Mean
PLW (%)	Kintin (0 ppm)	8.65	50.10	29.37
	Kinetin (15 ppm)	5.30	36.20	20.75
	Kinetin(20 ppm)	4.65	34.60	19.62
	Mean	6.20	40.30	-
	C.D. (P=0.05)	T =5.27	S =2.98	TxS=5.16
Rotting (%)	Kintin (0 ppm)	11.10	46.66	28.88
	Kinetin (15 ppm)	9.99	34.44	22.21
	Kinetin(20 ppm)	7.77	32.22	19.99
	Mean	9.62	37.77	-
	C.D. (P=0.05)	T =NS	S =5.29	TxS=NS
TSS (%)	Kintin (0 ppm)	9.10	9.30	9.20
	Kinetin (15 ppm)	10.20	10.40	10.30
	Kinetin(20 ppm)	10.70	10.50	10.60
	Mean	10.00	10.06	
	C.D. (P=0.05)	T =0.35	S =NS	TxS=NS
Acidity (%)	Kintin (0 ppm)	0.959	0.863	0.911
	Kinetin (15 ppm)	0.942	0.831	0.886
	Kinetin(20 ppm)	0.908	0.819	0.863
	Mean	0.936	0.838	-
	C.D. (P=0.05)	T =NS	S =0.068	TxS=NS
Vitamin C (mg/100 ml juice)	Kintin (0 ppm)	27.56	22.42	24.99
	Kinetin (15 ppm)	28.66	24.08	26.37
	Kinetin(20 ppm)	29.35	24.64	26.99
	Mean	28.52	23.71	
	C.D. (P=0.05)	T =0.197	S=1.02	TxS=NS
Juice (%)	Kintin (0 ppm)	47.70	45.80	46.75
	Kinetin (15 ppm)	48.05	47.60	47.62
	Kinetin(20 ppm)	48.50	48.00	48.25
	Mean	48.08	47.13	
	C.D. (P=0.05)	T =NS	S =0.19	TxS=0.335

and rotting per cent was found to be very slow in fruits treated with 20 ppm kinetin as compared to control and Kn (15 ppm). The PLW was minimum (19.62 % and 5.02 %) under ambient and cold storage conditions, respectively with 20 ppm kinetin. Similarly, the rotting per cent was minimum (19.99 % and 6.66 %) with Kn (20 ppm) under ambient and cols storage conditions. This may be because kinetin reduces senescence, the rate of respiration and ripening of fruits. Such studies have been reported earlier by Wade and Bradley (1973) in Banana and Dhillon *et al.* (1985) in grapes. The PLW and rotting % are remarkably less under cold storage conditions as compared to ambient conditions due to slow senescence under cold storage conditions.

Juice percentage and vitamin C :

The data presented clearly indicate that the juice content and vitamin C of kinnow fruit declined with advancement of storage period under both the conditions of storage. However, there was elevation in mean juice content and vitamin C by the kinetin application. The maximum, juice content (48.25 %) and vitamin C (26.99 mg/100 ml juice) were recorded in Kn (20 ppm) treated fruits under ambient conditions and the same trend has been observed under cold storage conditions. The higher juice and vitamin C of fruits under the treatment may be due to reduced moisture loss as reported earlier by Garg *et al.* (1976) in guava. The maximum vitamin C with Kn (20 ppm) may be due to reduced respiration rate as well as oxidation of fruits (Bhardwaj *et al.*, 2005, 2010).

TSS and acidity :

The TSS content was found to increase and the acidity declined with storage under both the conditions. The TSS content of fruits treated with kinetin was more as compared

Table 2: Effect of kinetin on physico – chemical characteristics of Kinnow fruits at different intervals under cold storage conditions

Parameters	Treatments	Storage period				
		Stage I (15 D)	Stage II (30 D)	Stage III (45 D)	Stage IV (60 D)	Mean
PLW (%)	Kintin (0 ppm)	0	7.77	11.10	16.22	8.77
	Kinetin(15 ppm)	0	4.44	8.66	12.22	6.83
	Kinetin(20 ppm)	0	2.33	6.66	11.10	5.02
	Mean	0	4.85	8.81	13.18	
	C.D. (P=0.05)	T =NS	S =2.10	TxS=NS		
Rotting (%)	Kintin (0 ppm)	1.90	5.40	16.75	25.25	12.32
	Kinetin(15 ppm)	1.75	3.50	11.25	17.65	8.54
	Kinetin(20 ppm)	1.65	3.25	10.10	11.65	6.66
	Mean	1.77	4.05	12.70	18.18	
	C.D. (P=0.05)	T =0.474	S =0.405	TxS=0.806		
TSS (%)	Kintin (0 ppm)	9.08	9.90	10.00	10.30	10.00
	Kinetin(15 ppm)	10.60	10.70	10.90	11.00	10.80
	Kinetin(20 ppm)	10.90	10.95	11.00	11.15	11.00
	Mean	10.43	10.52	10.63	10.82	
	C.D. (P=0.05)	T =0.077	S =NS	TxS=NS		
Acidity (%)	Kintin (0 ppm)	0.953	0.945	0.910	0.872	0.920
	Kinetin(15 ppm)	0.945	0.940	0.857	0.838	0.895
	Kinetin(20 ppm)	0.883	0.857	0.819	0.812	0.843
	Mean	0.927	0.914	0.862	0.841	
	C.D. (P=0.05)	T =0.016	S =0.023	TxS=NS		
Vitamin C	Kintin (0 ppm)	22.50	22.32	2193	21.00	21.73
(mg/100 ml juice)	Kinetin(15 ppm)	24.05	23.55	23.22	22.69	23.38
	Kinetin(20 ppm)	26.61	25.72	24.33	23.89	25.13
	Mean	24.39	23.86	23.16	22.53	
	C.D. (P=0.05)	T =1.25	S=1.18	TxS=NS		
Juice (%)	Kintin (0 ppm)	45.55	44.50	43.65	43.50	44.30
	Kinetin(15 ppm)	45.60	45.60	46.35	45.00	45.38
	Kinetin(20 ppm)	47.10	47.00	46.50	46.00	46.65
	Mean	46.08	45.70	45.17	44.83	
	C.D. (P=0.05)	T =NS	S=0.601	TxS=NS		

control because this treatment checks losses due to decay caused by metabolic changes. 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 and conversion in sugars and salts. 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.

The Kinetin treatment reduces chlorophyll degradation (Nagar, 1993) and polymethylyestearse, polygalactouranase and cellulose enzyme activities in stored kinnow fruits (Nagar, 1994) hence, improve storage period of these fruits.
Therefore, the shelf life of kinnow fruits can be extended up to 28 days and 60 days with the post harvest application of kinetin (20 ppm) under ambient and cold storage conditions, respectively without affecting the fruit quality of kinnow mandarin.

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