Environment & Ecology 29 (3) : 1060—1064, 2011
 ISSN 0970-0420

Evaluation of Heat Shrinkable Film Wrapping and Pedicel Retention on Sweet Orange (*Citrus sinensis* (L.) Osbeck) cv Malta Common for Storage

RAJESWARI DASMOHAPATRA, M .C. NAUTIYAL AND S. K. SHARMA

Department of Horticulture, College of Forestry & Hill Agriculture
Govind Ballabh Pant University of Agriculture and Technology
Hill Campus, Ranichauri, Pantnagar 249199, India
E-mail : mohapatrahort@gmail.com

Abstract

An experiment was conducted to assess the effect of pedicel retention and storage of fruits in individual shrink wrapping. It was observed that there was an increase in the physiological loss in weight and TSS of the fruits at 60 days storage while, the fruit firmness and titratable acidity declined consistently during the entire storage period. These changes were minimum in the fruit harvested with pedicel and packed in heat shrinkable polyolefin film. The weight loss was reduced to about/ 1/8th and the rotting to about 1/6th by storing the fruits in individual shrink wrapping. The shelf life could be enhanced to about 60 days by storing the fruits in heat shrinkable polyolefin film with attached pedicel.

Key words : Malta Commong, Individual shrink wrapping, Pedicel retention, Storage.

Citrus fruits occupy a predominant place in the fruit industry of Uttarakhand state. Among various citrus cultivars "Malta Common" is grown on a large scale in Punjab, Haryana, western district of Uttar Pradesh and in most of the hill districts of the state Uttarakhand. The high acceptability of "Malta Common" is due to its attractive color, distinctive flavor and taste. The excellent quality fruits are generally available for only one or two months due to its poor shelf-life. A huge proportion of citrus fruits are wasted in the country due to the incidence of rotting, mainly caused due to the occurrence of button hole injury, impact damage during improper harvesting and handling of the fruits (1). These post harvest losses can be minimized by proper harvesting of the fruits at an optimum maturity. Seal packaging of individual citrus fruits with shrinkable poly ethylene film, successfully doubling the shelf-life was first reported by Ben-Yehoshua (2). Since then several researchers reported on the usefulness of shrink-wrapping in citrus fruits as reported by Ladaniya et al. (3). However reports on shrink wrapping particularly in malta fruits are not available. Therefore, present study was undertaken to extend the shelf life of malta using individual shrink wrapping with attached pedicel.

Methods

The present investigations were carried out in the department of horticulture, G. B. Pant university of Agriculture & Technology, Hill campus, Ranichauri, Tehri Garhwal during December 2006 to March 2007. Approximately 3 quintals of mature yellowish sweet orange fruits of Sweet Orange cv Malta Common were harvested with the help of a secateur along with 2-3 mm long pedicel and a similar lot, by simply plucking the fruits from the trees i.e. without pedicel from Mandal valley area of district Chamoli, Uttarakhand in the month of December, 2006. From both pedicellate and non-pedicellate group one lot of fruits i. e. 7—8 fruits were packed in polythene bags 39 cm (1) × 24 cm (b) of (0.025 mm thickness), one lot were enclosed in heat shrinkable polyolefin film. The film was heat sealed with poly quick seal machine manufactured by BR electronics (India) and another lot of fruits were kept in open (control). These were stored under ambient temperature (temperature 10.20 to 23.9C and RH 65—70%). Nearly 3 kg fruits shall be kept under each treatment for determination of physico-chemical and sensory quality and about 1.5 kg fruits for recording PLW and evaluated initially before storage and at periodic intervals of 30 days, for different physical, physico-chemical and sensory quality attributes. The above treatments were replicated thrice. Standard analytical procedures were followed to estimate the various physico-chemical parameters of malta

Table 1. Effect of harvesting methods and packaging treatments on physiological loss in weight (%) of malta fruits during 90 days storage. ISW =Individual shrink wrapping, MAP = Modified atmosphere packaging * Figures in parenthesis are arc sine values.

Harvesting method	Packaging treatment	Storage interval (days) 30	60	90	Mean	Mean (P)
Without Pedicel	Open	0.90 (5.44)	2.72 (9.49)	3.63 (10.98)	2.42 (8.64)	2.94 (8.67)
	ISW	0.00 (0.00)	1.63 (7.34)	1.63 (7.34)	3.26 (4.89)	1.90 (4.16)
	MAP	0.00 (0.00)	0.94 (5.56)	2.35 (8.82)	1.10 (4.79)	1.04 (4.69)
	Mean	0.30 (1.81)	1.76 (7.46)	2.53 (9.05)	3.70 (6.11)	
With Pedicel	Open	0.00 (0.00)	3.77 (11.20)	6.60 (14.89)	3.46 (8.70)	
	ISW	0.00 (0.00)	0.80 (5.13)	0.80 (5.13)	0.53 (3.42)	
	MAP	0.00 (0.00)	0.98 (5.68)	1.96 (8.05)	0.98 (4.58)	
	Mean	0.00 (0.00)	1.85 (7.34)	3.12 (9.36)	1.66 (5.57)	
Grand mean (I)		0.15 (0.90)	1.81 (7.40)	2.83 (9.21)		
		$CD_{0.05}$			$CD_{0.05}$	
Harvesting method (H)		0.59		H × P	1.01	
Packaging treatment (P)		0.71		H × I	1.01	
Storage Interval (I)		0.71		P × I	1.24	
				H × P × I	1.76	

fruits. Periodical observations with regard to physical characteristics (PLW%, Rotting %, firmness) and chemical characteristics (TSS, acidity, ascorbic acid, total sugar) were recorded at 30, 60 and 90 days of storage. The appearance, taste, flavors and texture were recorded at 30, 60 and 90 days of storage. The appearance, taste, flavours and texture of each sample was evaluated organoleptically by the panel of 9 judges using 9 point hedonic scale, Amerin et al. (4).

Results and Discussion

The per cent PLW and rotting of fruits increased continuously with advancement of storage period (Tables 1 to 6). The weight loss of fruits at 90 days of storage was least (1.90%) in individually shrink wrapped fruits. The slight loss is due to the minimum PLW found in fruits sealed individually in polythene. The polyethylene or polyolefin films used for ISW of malta fruits do not permit the direct contact of fruit tissue with O_2 of the atmosphere thereby creating modified atmospheric conditions around the fruit. This reduce the rate of respiration of fruits and increases the shelf-life, Sharma and Nautiyal (1).

It was also observed that the fruits kept with

Table 2. Effect of harvesting methods and Packaging treatments on rotting (%) of malta fruits during 90 days storage. ISW = Individual shrink wrapping , MAP = Modified atmosphere packaging * Figures in parentheses are arc sine values.

Harvesting method	Packaging treatment	Storage interval (days) 30	60	90	Mean	Mean (P)
Without pedicel	Open	0.00 (0.00)	33.33 (35.26)	80.95 (64.12)	38.09 (33.13)	32.01 (29.29)
	ISW	4.76 (12.60)	13.69 (21.72)	17.27 (24.56)	11.91 (19.63)	7.54 (14.02)
	MAP	4.26 (11.91)	9.52 (17.97)	42.98 (40.97)	18.92 (23.62)	17.03 (21.10)
	Mean	4.51 (8.17)	18.85 (24.98)	47.07 (43.22)	23.69 (25.46)	
With pedicel	Open	0.00 (0.00)	22.22 (28.12)	55.55 (48.19)	25.92 (25.44)	
	ISW	0.00 (0.00)	14.76 (2.60)	4.76 (12.60)	3.17 (8.40)	
	MAP	0.00 (0.00)	12.50 (20.71)	32.93 (35.02)	15.14 (18.58)	
	Mean	0.00 (0.00)	13.16 (20.48)	31.08 (31.94)	14.75 (17.47)	
Grand mean (I)		2.26 (4.09)	16.01 (22.73)	39.08 (37.58)		
		$CD_{0.05}$				$CD_{0.05}$
Harvesting method (H)		0.63			S × P	1.09
Packaging treatment (P)		0.77			S × I	1.09
Storage Interval (I)		0.77			P × I	1.35
					S × P × I	1.90

Table 3. Effect of harvesting methods and Packaging treatments on fruit firmness (Kg/cm^2) of malta fruits during 90 days storage. Initial value = 9.73.

Harvesting method	Packaging treatment	Storage interval (days) 30	60	90	Mean	Mean (P)
Without Pedicel	Open	6.87	8.73	6.07	7.30	6.67
	ISW	8.13	8.00	7.10	8.24	8.18
	MAP	8.50	8.17	7.17	8.39	7.79
	Mean	7.83	7.63	6.78	7.99	
With Pedicel	Open	6.67	6.53	5.87	7.20	
	ISW	9.00	8.57	7.33	8.66	
	MAP	8.73	8.50	7.17	8.53	
	Mean	8.13	7.87	6.79	8.13	
Grand mean (I)		7.98	7.75	6.79	8.03	
		$CD_{0.05}$				$CD_{0.05}$
Harvesting method (H)		NS			S × P	NS
Packaging treatment (P)		0.69			S × I	NS
Storage Interval (I)		0.60			P × I	NS
					S × P × I	NS

pedicel suffered a mean 14.75% rotting compared to 23.69% without pedicel. These results are in conformity with Prakash et al. (5), who had recorded maximum rotting and fruit weight loss in plum fruits plucked without pedicel owing to exposed surface of pedicel. The other possible reason for maximum physiological fruit weight loss in non-pedicellate fruit might be attribute to higher rate of respiration and evaporation loss due to exposed surface at distal end. With regard to packaging materials, maximum percentage of rotting was observed in the fruits kept open without any packaging and minimum in the shrink-wrapped fruits (7.54%).

The mean fruit firmness was maximum (8.18 kg/cm^2) in individually shrink wrapped fruits and minimum (6.67 kg/cm^2) in fruits kept without any packaging. The decrease in fruit firmness from 9.73 to 6.20 kg/cm^2 during 90 days storage (Table 3) was probably due to the enzymatic degradation of insoluble protopection to the more soluble pectic acid and pectinates (6). The retention of higher firmness with HDPE (High density polyethylene) films may be due to their capability to reduce moisture loss from the peel thus maintaining the cell wall turgidity and tissue rigidity.

The TSS content increased from 8.60 to 10.14%

Table 4. Effect of harvesting methods and Packaging treatments on total soluble solids (^{0}Brix) of malta fruits during 90 days storage. Initial value = 8.60.

Harvesting method	Packaging treatment	Storage interval (days) 30	60	90	Mean	Mean (P)
Without pedicel	Open	9.67	10.00	10.50	9.70	9.64
	ISW	9.50	9.77	9.40	9.32	9.17
	MAP	9.67	9.83	9.87	9.50	9.50
	Mean	9.61	9.87	9.93	9.50	
With Pedicel	Open	8.67	9.06	9.19	8.87	
	ISW	9.00	8.33	8.57	8.63	
	MAP	8.67	8.93	9.13	8.83	
	Mean	8.78	8.77	8.94	8.77	
Grand mean (I)		9.20	9.32	9.44	9.14	
		$CD_{0.05}$			$CD_{0.05}$	
Harvesting method (H)		0.26		S × P	NS	
Packaging treatment (P)		0.37		S × I	NS	
Storage Interval (I)		0.32		P × I	NS	
				S × P ×I	NS	

Table 5. Effect of harvesting methods and Packaging treatments on ascorbic acid (mg/100ml) of malta fruits during 90 days storage. Initial value = 60.80.

Harvesting method	Packaging treatment	Storage interval (days) 30	60	90	Mean	Mean (P)
Without pedicel	Open	54.22	56.0	53.12	55.18	55.41
	ISW	59.76	57.33	54.78	55.17	57.88
	MAP	59.76	57.33	54.78	55.17	57.31
	Mean	55.91	56.89	54.23	57.46	
With pedicel	Open	52.12	56.00	53.12	55.51	
	ISW	59.78	59.33	55.91	58.96	
	MAP	59.78	59.00	55.91	58.96	
	Mean	57.23	58.22	54.98	57.81	
Grand mean (I)		57.57	57.56	54.61	57.64	
		$CD_{0.05}$			$CD_{0.05}$	
Harvesting method (H)		NS		S × P	NS	
Packaging treatment (P)		1.55		S × I	NS	
Storage Interval (I)		1.34		P × I	NS	
				S × P × I	NS	

with the progress in storage period, which might be due to hydrolysis of starch and pectic substances and accumulation of sugars. Similar results were reported in Kinnow with the advancement of storage period by Lotha et al. (7). It was also noticed that the mean total soluble solids was found to be higher (9.64 ^{0}Brix) in open fruits (without packing) as compared to the fruits wrapped individually in polythene (9.17 ^{0}Brix). Further, the value of mean TSS for fruits packed in MAP was 9.50 ^{0}Brix. The higher mean values of TSS obtained in fruits kept open without packing might be due to the higher ratio of respiration in this treatment as compared to the rest of the treatments. The pedicellate fruits showed lesser mean TSS (9.14 ^{0}Brix) as compared to those fruits stored without pedicel (9.74 ^{0}Brix).

During 90 days storage, the mean ascorbic acid experienced a loss of 11.10 % . Further these losses were 4.80 and 8.87% in fruits packed in individual shrink wrapping and without packing respectively and a loss of 5.74 %found in fruits packed in a group of 7—8 in polythene bags. Mahajan et al. (8) reported the effect of HDPE (high density polyethylene) film to reduce loss of ascorbic acid as it, probably, helped in lowering the respiration rate or oxidation of ascorbic acid content of the fruit. But whatever decrease in ascorbic acid during storage is due to conversion of ascorbic acid into dehydroascorbic acid (9). Further,

Table 6. Effect of harvesting methods and Packaging treatments on overall acceptability of malta fruits during 90 days storage.

Harvesting method	Packaging treatment	Storage interval (days) 30	60	90	Mean	Mean (P)
Without pedicel	Open	5.21	6.87	5.25	5.78	6.85
	ISW	6.92	7.14	7.14	7.07	7.29
	MAP	6.01	6.92	6.28	6.40	7.06
	Mean	6.05	6.98	6.22	6.42	
With pedicel	Open	6.23	7.07	7.25	6.85	
	ISW	7.50	8.50	8.00	8.00	
	MAP	7.50	7.50	8.00	7.67	
	Mean	7.08	8.02	7.75	7.62	
Grand Mean (I)		6.57	7.50	6.99	7.62	
		$CD_{0.05}$	$CD_{0.05}$		$CD_{0.05}$	
Harvesting method (H)		0.09	0.09	S × P	NS	
Packaging treatment (P)		0.11	0.11	S × I	0.11	
Storage Interval (I)		0.11	0.11	P × I	0.13	
				S × P × I	0.01	

vitamin C content of fruits stored in the fruits with pedicel after 90 days of storage was 57.81 mg/100 ml as compared to 57.46 in fruits without pedicel (Table 5).

Table 6 shows the quality rating of the consumer overall acceptibity on the basis of skin color, taste,flavor, texture and juiceness of fruits decreased with an increase in storage period. Similarly results were reported by Bhardwaj and Sen (10). However higher organoleptic score was obtained for pedicellate fruits with individual shrink wrapping. Possible explanation for good organoleptic score of fruits where pedicel retain might be due to no change in qualitative characters and palatability of fruits, which result in minimum PLW and helped in maintaining acidity, TSS, TSS/acid ratio and sugars in balanced from due to lesser production of CO_2 and C_2H_4 compared with non-pedicellate fruit. (11) and shrink wrapping helped on delayed loss of fruit and peel colouration and also containment of decayed fruit to single sealed unit.

References

1. Sharma S. K. and M. C. Nautiyal. 2007. *Postharvest management of Malta. Low Cost Technology for Storage and Value addition.* Tech. Bull. No. FHA/17/Hort./07. Univ. Hort. and Forestry, Ranichauri, India.
2. Ben-Yehoshua S. 1978. *Delaying deterioration of individual citrus by seal-packaging in film of high density polyethylene-General effects*. P. R. Cary (ed.) *In* Proc. Int. Soc. Citricul. Sydney, Australia.
3. Ladaniya M. S., R. K. Sonkar and H. C. Das. 1997. Evaluation of heat shrinkable film wrapping of Nagpur mandarin (*Citrus reticulata* Bleanco) for storage. *J. Food Sci. Tech.* 34 : 324—327.
4. Amerin M. A., R. M. Pangborn and E. B. Roessler. 1965. *Principles of sensory evaluation of food.* Academic Press, London, UK.
5. Prakash S., M. C. Nautiyal and S. K. Lavania. 1997. Effect of fruit pedicel on storage behavior of 'Santa Rosa' plum. *Ind. J. Agri. Sci*. 67 : 273—274.
6. Sinclair W. B. and V. A. Jollife. 1958. Free galacturonic acid in citrus fruits. *Bot Gaz.* 120 : 117—121.
7. Lotha R. E., D. S. Khurdiya and M. K. Maheshwari. 1994. Effect of storage on the quality of Kinnow mandarin fruit for processing. *Ind. Fd. Packer.* 48 : 25—38.
8. Mahajan B. V. C., W. S. Dhillon and A. S. Dhatt. 2004. Effect of pre-storage treatments on the quality and storage life of asian pear. *Ind. J. Hort*. 61 : 342—344.
9. Gustafen F. G., and A. R. Cooke. 1952. Oxidation of ascorbic acid to dehydro-ascorbic acid at low temperature. *Science.* 116 : 234—239.
10. Bhardwaj, R. L. and N. L. Sen. 2003. Zero energy cool chamber storage of mandarin cv. 'Nagpur Santra'. *J. Food Sci. Tech*. 49 : 669—672.
11. Mitra S. K., D. S. Rathore and T. K. Bose. 1991. Apricot. Pp. 279—299. *In Temperate fruit horticul ture.* Allied Publ. Kolkata, India.