

EFFECT OF PEDICEL RETENTION AND ZERO ENERGY COOL CHAMBER ON STORAGE BEHAVIOUR OF MALTA FRUITS

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Abstract- An experiment was conducted to access the effect of pedicel retention and storage of malta fruits in zero energy cool chamber (ZECC). It was observed that there was an increase in the physiological loss in weight and TSS of the fruits during 90 days storage, while, the fruit firmness and titratable acidity declined consistently during the entire storage period. These changes were minimum in the fruits harvested with pedicel and stored under ZECC. The weight loss and the rotting were reduced to about half by storage of fruits in ZECC. The shelf-life could be enhanced to about 90 days by storing the fruits in ZECC with attached pedicel.

Keywords: *Citrus sinensis*, malta, storage, zero energy cool chamber, pedicel retention.

INTRODUCTION

Citrus fruits occupy a predominant place in the fruit industry of Uttarakhand state sharing about 14.38 percent of the total area under fruits and contributing about 17.75 percent to the total fruit production [1]. The most important commercial citrus cultivar is sweet orange. Among these cultivars "Malta Common" is grown on a large scale in Punjab, Haryana, Uttarakhand and western district of Uttar Pradesh. "Malta Common", one of the important cultivar of citrus fruit, is grown in most of the hill districts of the state Uttarakhand like Ghat, Mandal, Nagnath Pakhari area of district Chamoli, Quiti, Thal, Berinag, Didihat of district Pithoragarh, and some areas of district Rudraprayag etc. The high acceptability of "Malta Common" is due to its attractive colour, distinctive flavour and taste. The excellent quality fruits are generally available for only one or two months. However owing to its poor shelf-life, fruits can not be stored for longer period under ambient conditions and cannot be transported to distant places. By and large this fruit is harvested by shaking the tree or manually twisting and plucking. Citrus fruits are non-climacteric in nature and their eating quality can not be improved after harvest. So it is necessary to harvest the fruits when their internal quality is at their best. The harvesting of fruit along with small pedicels has been reported to enhance the shelf-life and retention of quality during storage [2- 4]. The facility of cold storage is beyond the reach of marginal farmers; therefore, the use of Zero Energy Cool Chamber (ZECC) may prove beneficial for the farmers. The present study was therefore, conducted to access the postharvest behaviour of malta fruits with respect to pedicel retention and storage in ZECC.

MATERIALS AND METHODS

Mature yellowish sweet orange fruits of 130 to 240g weight, 6.0 to 7.8 cm diameter, 7.5 to 10 °Brix TSS, 0.66 per cent acidity of cv. Malta Common were harvested from private orchards of Mandal area in district Chamoli, Uttarakhand, India and brought to the Post-harvest laboratory of Department of Horticulture, Hill campus, Ranichauri, in the month of December, 2006. The fruits after thorough sorting were washed in running tap water followed by drying in shade. The fruits with and without pedicel were separated, and divided further into two lots. The length of pedicel was kept 2-3mm. These were stored under two different conditions i. e. ambient (temperature 10.20 to 23.9°C and RH 65-70 %) and Zero energy cool chamber [temperature 3.10 to 14.60°C and RH 90-95 %], (163cm (l) x 120cm (b) x 68cm (h), internal dimensions] for a period of 90 days and the observations pertaining to various quality parameters were recorded at periodic intervals of 30 days. The experiment was laid out in Factorial Completely Randomized Design [5]. Standard analytical methods were followed for recording various parameters. The percent physiological loss in weight was determined by calculating the loss in weight loss was determined by calculating the loss in fruit weight during storage over initial values. Rotting percentage was calculated on the basis of total number of fruit rotten in each treatment at the end of storage period. Fruit firmness was measured by making two readings on opposite faces of the fruit, with an Effigy penetrometer (Model FT 011). TSS of fruits was measured with the help of an Erma hand refractometer and was corrected using standard reference tables and expressed in terms of °Brix at 20°C. Titratable acidity was determined by the aliquot against 0.1N NaOH solution as described by [6]. The appearance, taste,

flavors and texture of each sample was evaluated organoleptically by the panel of 9 judges using 9 point hedonic scale [7].

RESULTS AND DISCUSSION

The physiological loss in weight was significantly affected by the retention of pedicel on malta fruits and their storage in ZECC (Table 1). There was about 2.17 and 13.54 per cent mean weight loss in malta fruits when harvested with pedicel and stored in ZECC for 90 days as compared to their counterparts harvested without pedicel and stored at ambient conditions. The lower temperature and higher relative humidity in ZECC and the pedicel retention must have reduced the respirational and transpirational losses thereby resulting in lower mean weight loss of 6.69 percent was observed in malta fruits irrespective of pedicel retention and storage condition. Lower weight loss in fruits of apple cv. Royal Delicious stored in ZECC as compared to fruits stored at ambient conditions has also been reported earlier.

The firmness of malta fruits declined with the advancement in period of storage from 7.25 to 6.21 kg/cm² (Table 2), which might be due to the breakdown of insoluble protopectins, a major component of cell wall, into water soluble compounds, during storage, which ultimately affected the cell wall consistency or softening of fruit skin as has also been reported earlier [8, 9, 10]. It was also observed that the mean firmness was higher (7.50kg/cm²) in fruits with pedicel as compared to those without pedicel (6.15kg/cm²) and fruits stored in ZECC (6.91kg/cm²) than that of those stored at ambient conditions (6.74kg/cm²).

The mean TSS of malta fruits increased from 6.33 to 10.00 °Brix and the mean titratable acidity declined from 0.67 to 0.55 per cent after 90 days of storage (Table 3 and 4). The increase in TSS was probably due to breakdown of starch and other complex carbohydrates into simple sugars and the transpiration loss of moisture from the fruits, while, the decline in acidity of fruits during storage might be attributed to utilization of organic acids in respiration and other metabolic processes. Increases in TSS of mandarin have also been reported earlier [11]. Further, the changes in TSS and acidity of the fruits stored in ZECC were less as compared to that of those stored under ambient conditions. Similarly, the pedicellate fruits also experienced lesser changes in their TSS and acidity during 90 days storage at both the storage conditions. Similar results were reported in Kinnow with the advancement of storage period by [12].

The rotting percentage of fruits was reduced to about half by storage in ZECC (Fig. 1). Also, the rotting incidence was reduced due to retention of pedicel during storage of fruits by two folds. This might be due to the fact that the entry points for micro-organisms from the pedicel end remained closed in the fruits where the pedicel was attached, while the micro-organisms could easily enter the fruit from the point of detachment of pedicel thus causing more rotting at ambient temperatures which are conducive for their growth and reproduction.

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Table I- Effect of harvesting method and storage conditions on the physiological loss in weight (%) of malta fruits.

Storage interval(days)	Without pedicel		With pedicel			Mean(l)	
	Ambient	ZECC	Mean	Ambient	ZECC	Mean	
30	4.82	2.08	3.45	0.30	0.00	0.15	1.80
60	10.52	6.19	8.36	1.75	1.85	1.80	5.08
90	13.15	7.95	10.55	2.54	3.12	2.83	6.69
Mean	9.50	5.41	7.45	1.53	1.66	1.56	
Mean(S)	5.52	3.54					
CD _{0.05} Pedicelattachment(P)			0.255				
Storage condition(S)			0.255				
Storage interval (I)			0.313				
P x S			0.361				
P x I			0.442				
S x I			0.442				
P x S x I			0.626				

Table II- Effect of harvesting method and storage conditions on the fruit firmness (kg/cm²) of malta fruits.

Storage interval(days)	Without pedicel		With pedicel			Mean(l)	
	Ambient	ZECC	Mean	Ambient	ZECC	Mean	
30	6.41	6.61	6.51	7.83	8.13	7.98	7.25
60	6.31	6.32	6.32	7.63	7.87	7.75	7.04
90	5.50	5.74	5.62	6.78	6.79	6.79	6.21
Mean	6.07	6.22	6.15	7.41	7.60	7.50	
Mean(S)	6.74	6.91					
CD _{0.05} Pedicelattachment(P)			0.305				
Storage condition(S)			NS				
Storage interval (I)			0.374				
P x S			NS				
P x I			NS				
S x I			NS				
P x S x I			NS				

Table III- Effect of harvesting method and storage conditions on the TSS (°Brix) of malta fruits.

Storage interval(days)	Without pedicel		With pedicel			Mean(l)	
	Ambient	ZECC	Mean	Ambient	ZECC	Mean	
30	9.81	9.05	3.45	9.61	8.78	9.20	6.33
60	10.38	9.87	8.36	9.87	8.77	9.32	8.84
90	11.14	10.55	10.55	9.93	8.94	9.44	10.00
Mean	10.44	9.82	7.45	9.80	8.83	9.32	
Mean(S)	10.12	9.33					
CD _{0.05} Pedicelattachment(P)			0.274				
Storage condition(S)			0.274				
Storage interval (I)			0.335				
P x S			NS				
P x I			0.474				
S x I			NS				
P x S x I			NS				

Table IV- Effect of harvesting method and storage conditions on the titratable acidity (%) of malta fruits.

Storage interval(days)	Without pedicel		With pedicel			Mean(I)	
	Ambient	ZECC	Mean	Ambient	ZECC	Mean	
30	0.63	0.64	0.64	0.68	0.70	0.69	0.67
60	0.54	0.62	0.58	0.64	0.66	0.65	0.62
90	0.53	0.54	0.54	0.55	0.56	0.56	0.55
Mean	0.56	0.60	0.58	0.62	0.64	0.63	
Mean(S)	0.59	0.62					
CD _{0.05} Pedicelattachment(P)			0.03				
Storage condition(S)			NS				
Storage interval (I)			0.036				
P x S			NS				
P x I			NS				
S x I			NS				
P x S x I			NS				

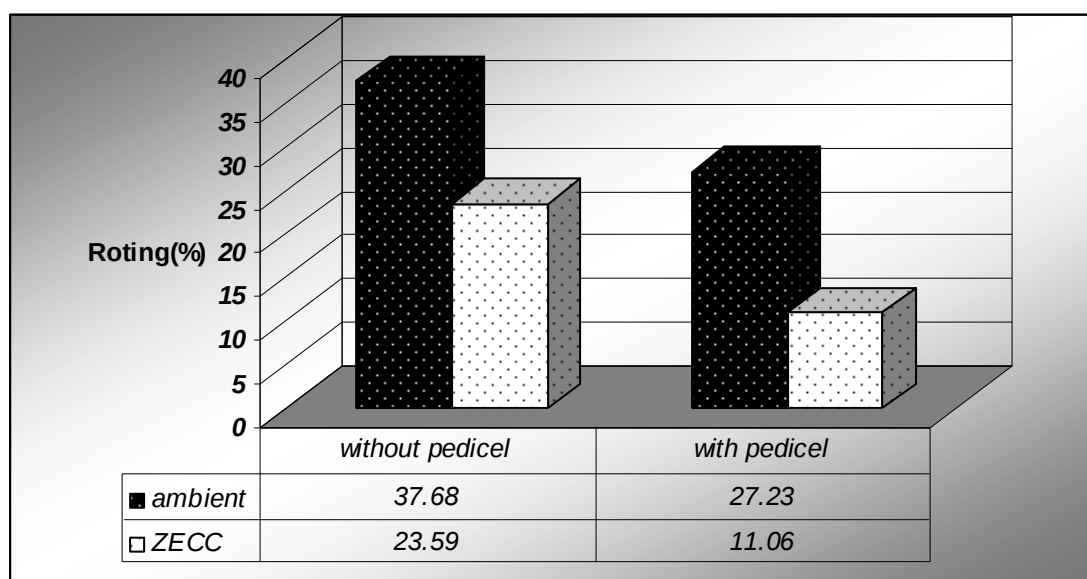


Fig. I- Effect of pedicel retention and storage conditions on rotting (%) of malta fruits after 90 days storage.