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Effect of 1-methylcyclopropene on storage life and quality of peaches

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ABSTRACT

The fruits of peach cv. Shan-e-Punjab were harvested at colour break stage and treated with 1-MCP (500 and 1000 ppb) gaseous vapours for 24 h at 20°C. Thereafter, the fruits were packed in corrugated fibre board boxes of 2 kg capacity and stored at 0-1°C and 90-95% RH. The control fruits were also kept under same conditions without any treatment. The observations for various physiological and biochemical constituents were recorded at weekly intervals till 4 weeks. The data revealed that fruits treated with 1-MCP (1000 ppb) resulted in minimum weight loss, retained acceptable texture and maintained desirable organoleptic quality till four weeks of storage. On the other hand, the control fruits maintained acceptable quality only upto two weeks.

Key words: Peach, 1-MCP, cold storage, storage life, quality.

INTRODUCTION

In Punjab, peach is cultivated on an area of 1596 ha, with an annual production of 23,940 MT (Anon, 2). 'Shan-e-Punjab' is the leading cultivar of peach, widely accepted by the growers because of its better size, juicy pulp and crisp texture. The harvesting of Shan-e-Punjab peach starts in May and generally, this period coincides with high temperature, which interferes with post-harvest quality and marketability of the fruits (Pongener *et al.*, 11). Hence, the farmers are forced to sell their produce at throw-away prices. Due to concentrated harvesting, there is glut of peaches in market, which also results in huge postharvest losses. Storage of peach fruits in cold storage coupled with safe postharvest treatments is a viable option to reduce the postharvest losses and regulating the market supply of fruits in distant markets.

1-methylcyclopropene (1-MCP) is a new chemical used widely for extending the shelf-life and quality of fruits in several countries abroad (Watkins, 13). It blocks ethylene receptors and prevents ethylene effects in plant tissues for extended period (Sisler and Serek, 12). Therefore, in the present investigations an attempt has been made to test the bio-efficacy of this compound on Shan-e-Punjab peach grown under Punjab conditions with a view to study its effects on storage life as well as quality.

MATERIALS AND METHODS

The present study was conducted in postharvest laboratory at Punjab Horticultural Postharvest Technology Centre, Punjab Agricultural University, Ludhiana during the year 2008-09. The fruits of peach cv. Shan-e-Punjab were harvested at colour break stage. The bruised and diseased fruits were sorted out and only healthy, uniform sized fruits were selected for the present studies. The fruits were exposed to two concentrations of 1-MCP, *viz*., 500 ppb and 1000 ppb gaseous vapours in an air tight closed chamber maintained at 20°C temperature for 24 h. After treatment, the fruits were packed in corrugated fibre board boxes and stored in walk-in cold room maintained at 0-1°C and 90-95% RH. There were three treatments and four storage intervals. The experiment was laid out in completely randomized design with three replications for each treatment. The observations on various physico-chemical attributes were monitored at weekly interval till four weeks of storage. The physiological loss in weight (PLW) of the fruits was calculated on initial weight basis and expressed in per cent. The fruit firmness was measured with the help of penetrometer (Model FT-327) using a probe of 8 mm in diameter and results expressed in terms of lb force. The sensory quality of the fruit was determined by a panel of ten judges using 9 point Hedonic scale (Amerine *et al.*, 1). The total soluble solid (TSS) of the juice was determined with the help of a Erma hand refractometer, and expressed in percent after making the temperature correction at 20°C.The total sugars and titratable acidity was estimated as per standard methods (A.O.A.C. 3). The colour of the fruits was measured with colour difference meter (Model: Mini Scan XE Plus, Made: Hunter Lab, USA) and expressed as L, a, b Hunter colour values (Hunter, 8).

RESULTS AND DISCUSSION

The per cent PLW, in general, increased with the advancement in storage period rather slowly in the beginning but at a faster pace as the storage period

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advanced (Table 1). The lowest mean PLW (2.9%) was observed in fruits treated with 1-MCP (1000 ppb) which was found to be statistically significant as compared to other treatments. On the other hand, the highest mean PLW (5.8%) was observed in control fruits. During different storage intervals, 1-MCP treatments (1000 ppb) registered the lowest weight loss ranged between 1.2 to 4.5 per cent from 7 to 28 days of cold storage, respectively as compared to control where PLW ranged from 2.7 to 8.3 per cent during same intervals. The reduction in weight loss in 1-MCP treated fruits may be attributed to delay in respiration rate (Dong *et al*., 5) and maintenance of tissue rigidity of the fruits.

Fruit firmness, in general, followed a declining trend commensurate with advancement in storage period (Table 1). The fruits treated with different concentrations of 1-MCP maintained higher firmness as compared to control at all storage intervals. The maximum mean fruit firmness (9.3 lb force) was observed in fruits treated with 1-MCP (1000 ppb), while the lowest firmness was noticed in control fruits (5.6 lb force). The fruit treated with 1-MCP (1000 ppb) maintained higher fruit firmness throughout the stipulated storage period of 4 weeks and ranged between 11.4 to 7.0 lb force as compared to control fruits which experienced the faster loss of firmness during storage and ranged between 8 to 3.2 lb force, thereby leading to excessive softening and shriveling of fruits. Softening of fruits is caused either by breakdown of insoluble protopectins into soluble pectin or by hydrolysis of starch. The maintenance of higher firmness as a result of 1-MCP may be due to their ability to prevent the physiological weight loss during storage and to inhibit/delay ethylene production and/or action in different fruits (Dong *et al*., 5).

The mean sensory quality score was significantly the highest (7.4) in fruits treated with 1-MCP (1000 ppb). On the other hand, the control fruits recorded the lowest score (6.1). Initially, the control fruits recorded the highest sensory score (8.0) after 14 days of storage and fruits were rated as very much acceptable but thereafter sudden decline in sensory quality was noticed and fruits registered a score of 5.5

Table 1. Effect of 1-MCP on physiological loss in weight (PLW), firmness and sensory quality of peaches during cold storage.

Storage period (days)	1-MCP (ppb)			
	0	500	1000	Mean
PLW (%)				
7	2.7	1.6	1.2	1.8
14	5.4	3.5	2.0	3.6
21	6.9	4.8	3.5	5.1
28	8.3	6.0	4.5	6.3
Mean	5.8	4.0	2.8	
$CD_{0.05}$ Treatment = 0.3 Storage = 0.2 Treatment × storage = 0.6				
Firmness (lb force)				
7	8.0	10.9	11.4	10.1
14	6.5	8.2	10.2	8.3
21	4.6	7.3	8.4	6.8
28	3.2	6.0	7.0	5.4
Mean	5.6	8.1	9.3	
$CD_{0.05}$ Treatment = 0.5 Storage = 0.3 Treatment × storage = 1.2				
Sensory quality (1-9)				
7	7.0	6.5	6.5	6.7
14	8.0	7.5	7.5	7.7
21	5.5	7.0	8.0	6.8
28	4.0	6.0	7.5	5.8
Mean	6.1	6.8	7.4	
$CD_{0.05}$ Treatment = 0.2 Storage = 0.3 Treatment × storage = 0.5				

Values at harvest: Firmness =12 lb force; Sensory quality = 5.0

and 4.0 after 21 and 28 days of storage, respectively (Table 1). The fruits treated with 1-MCP (1000 ppb) showed the highest sensory quality (8.0) after 21 days of cold storage and the fruits were rated as very much desirable. The improvement in palatability rating with 1-MCP has been reported in guava (Mahajan and Singh, 9) and pear (Mahajan *et al*., 10).

The acidity of peach fruits experienced a linear decline as the storage period advanced (Table 2). However, the loss of acidity during storage was gradual in 1-MCP treated fruits whereas, it declined at faster pace in case of control fruits. The highest mean acidity content (0.38%) was observed in 1-MCP (1000 ppb) treated fruits, whereas, it was the lowest (0.29%) in the control fruits. The fruits treated with 1-MCP maintained higher acidity during storage probably due to delay in ripening process. Fan *et al.* (6) observed lower acidity loss during storage in peach treated with 1-MCP.

The total soluble solids (TSS) content increased slowly and steadily up to 21 days of storage and thereafter declined gradually in 1-MCP treated fruits (Table 2). On the other hand, in control, the TSS content increased up to 14 days and thereafter sharp decline was noticed indicating rapid metabolic breakdown in these fruits. 1-MCP (1000 ppb) treated fruits recorded the highest TSS content (12%) after 21 days of storage and thereafter TSS content declined but fruits maintained the highest TSS (11.2%) even after 28 days of storage. The control fruits registered the highest TSS content upto 14 days of storage (11.5%) as compared to treated fruits and thereafter declined at a faster pace and recorded the lowest TSS as compared to 1-MCP treated fruits. The similar trend was also noticed in case of total sugar contents (Table 2). The highest total sugars (9.0%) was noticed in 1-MCP (1000 ppb) treated fruits after 21 days of storage and declined thereafter, while the untreated fruits recorded the maximum total sugars (7.6%) after 14 days of storage and decreased afterwards. The increase in TSS and total sugars during storage may possibly be due breakdown of complex organic metabolites into simple molecules or due to hydrolysis of starch into sugars. On complete hydrolysis of starch no further increase in sugars occurs and subsequently a decline in these parameters is predictable as they

Table 2. Effect of 1-MCP on acidity, TSS and total sugars in peaches during cold storage.

Storage period (days)	1-MCP (ppb)			
	0	500	1000	Mean
Acidity (%)				
7	0.40	0.43	0.46	0.43
14	0.30	0.35	0.40	0.35
21	0.25	0.30	0.34	0.30
28	0.21	0.28	0.31	0.27
Mean	0.29	0.34	0.38	
$CD_{0.05}$ Treatment = 0.3 Storage S = 0.2 Treatment × storage = 0.7				
TSS (%)				
7	10.7	10.5	10.2	10.5
14	11.5	11.0	11.0	11.2
21	10.0	11.6	12.0	11.2
28	9.0	11.0	11.8	10.6
Mean	10.3	11.0	11.3	
$CD_{0.05}$ Treatment = 0.5 Storage = 0.3 Treatment × storage = 0.9				
Total sugars (%)				
7	7.3	7.0	7.0	7.1
14	7.6	7.5	7.8	7.6
21	6.9	8.6	9.0	8.2
28	5.4	6.8	8.4	6.9
Mean	6.8	7.5	8.1	
$CD_{0.05}$ Treatment = 0.4 Storage = 0.2 Treatment × storage = 1.3				

Values at harvest: Acidity = 0.52; TSS = 9.0; Total sugars = 5.8

Table 3. Effect of 1-MCP on the colour of peaches during cold storage.

Storage period (days)	1-MCP (ppb)		
	0	500	1000
	Hunter Colour Values		
7			
L	59.92	57.11	58.42
a	7.64	5.33	5.00
b	26.07	24.87	24.28
14			
L	59.26	60.46	59.11
a	9.85	8.40	8.10
b	28.96	25.37	25.00
21			
L	55.07	62.45	62.93
a	9.65	9.31	9.22
b	23.30	27.29	26.15
28			
L	53.62	61.32	63.81
a	7.70	9.55	10.04
b	21.75	28.50	29.32

Value at harvest: L= 56.51; a = 4.21; b= 23.63

along with other organic acids are primary substrate for respiration (Wills *et al*., 14). In 1-MCP treated fruits, the increase in TSS and total sugars up to 21 days and gradual declined thereafter as compared control fruits where increase in TSS and sugars was noticed up to 14 days and sharp decline thereafter, indicating the possible role of these compounds in delaying metabolic activity of fruits during ripening and storage (Fan *et al.*, 7).

The data on Hunter colour values of peach fruits revealed that there was better yellow colour development in the control fruits up to 14 days of storage after which a declining trend in L, a, b value was observed leading to unpleasant colour of the fruit (Table 3). However, in 1-MCP (1000 ppb) treated fruits the red and yellow colour (a and b-value) increased gradually till four weeks of storage resulting in development of uniform colour fruits surface. The retention of acceptable colour in guava and pear with 1-MCP application during storage and ripening have also been reported by Bassetto *et al*. (4), and Mahajan *et al*. (10)

From the present studies it may be concluded that Shan-e-Punjab peach fruits treated with 1-MCP (1000 ppb) can be stored for 4 weeks at 0-1°C and 90-95% RH. The fruits maintained highly acceptable quality during storage. The postharvest application of 1-MCP on 'Shan-e-Punjab' peach fruits seems to hold promise in extending the marketable period and likewise reduce the postharvest losses.

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