



P-ISSN: 2349-8528
 E-ISSN: 2321-4902
 IJCS 2017; 5(5): 1598-1603
 © 2017 IJCS
 Received: 17-07-2017
 Accepted: 18-08-2017

AV Mane
 Department of Crop Physiology,
 University of Agricultural
 Sciences, Dharwad, Karnataka,
 India

MB Chetti
 Department of Crop Physiology,
 University of Agricultural
 Sciences, Dharwad, Karnataka,
 India

MM Burondkar
 Department of Crop Physiology,
 University of Agricultural
 Sciences, Dharwad, Karnataka,
 India

MC Kasture
 Department of Crop Physiology,
 University of Agricultural
 Sciences, Dharwad, Karnataka,
 India

Correspondence
AV Mane
 Department of Crop Physiology,
 University of Agricultural
 Sciences, Dharwad, Karnataka,
 India

Influence of different concentrations of 1-methylcyclopropene doses and storage conditions on quality and organoleptic evaluation in alphonso mango (*Mangifera indica* L.)

AV Mane, MB Chetti, MM Burondkar and MC Kasture

Abstract

Investigations were carried out, for two consecutive years (2010-11 and 2011-12), with an objective to test the effect of 1- methylcyclopropene (1-MCP) under different storage conditions on physico-chemical properties and organoleptic evaluation of Alphonso mango fruit observed after prolonged shelf life during transportation. After harvesting at physiological maturity, followed by pre-cooling at 13 °C, fruit were exposed to vapors of 1-MCP @ 70 mg/m³ (1000 ppb) for 18 hrs in air tight (plastic) treatment chamber. The treated and untreated fruits were then transferred to different storage conditions for different intervals (7, 14, 21, and 26 days). The fruit quality assessed at different intervals viz. after 7, 14, 21 and 26 days of storage and shelf life behavior after storage in terms of TSS, Acidity, total sugar and reducing sugar. Treatment combination of 1-MCP at 2000 ppb concentration and cold storage at 13 ±1°C found effective in maintaining the quality of fruits even after 26 days storage as compared to control in 21 DAT. The fruits treated with higher concentrations of 1-MCP and kept under cold storage yielded slow rise in vitamin A content with further decline after reaching the peak values till the end of storage whereas the ascorbic acid content untreated ambient control fruits was significantly decreased as compared to other treatment combinations. The organoleptic evaluation obtained at optimum ripening showed no significant difference in taste, aroma and flavor in all the treatment combinations, whereas 1-MCP treated fruits with cold storage showed less occurrence of spongy tissue with better colour visibility when fruits were treated with 2000 ppb 1-MCP.

Keywords: alphonso, 1-MCP, ripening, storage, aroma

Introduction

Konkan region of Maharashtra state is one of the biggest mango growing belt in the country, Maharashtra occupying 455.8 thousand ha of area, which accounts for about 19.68% of the total area under mango in the country (Anonymous, 2010). This region is traditionally known for commercial cultivation of world famous, prime Indian export mango variety 'Alphonso'. Due to its excellent fruit quality, the variety is in great demand both in domestic as well as in international markets. Beside the export to Middle East countries, Alphonso is increasingly gaining popularity in European countries and holds tremendous potential for future export. In recent time, a compound 1-Methyl cyclopropene (1- MCP) with strong ability to bind the site of ethylene receptor, has been shown to significantly delay the ripening process and substantially extended the storage and shelf life of number of fruit including mango. However, it is very much necessary to assess and optimize the concentration of 1-MCP and proper storage conditions so that there would be minimum loss in quality parameters of Alphonso mango when the fruits are brought for sale in the market after prolonged storage. Thus present studies were aimed at evaluating the effect of various concentrations of 1-MCP and different storage conditions on physico-chemical properties and organoleptic evaluation during prolonged storage of Alphonso mango fruits.

Material and methods

Experiment was conducted for 2 consecutive years (2010-11 and 2011-12) where in Alphonso mango fruit were harvested at 'B' stage (3.01 to 3.02 Specific gravity) of physiological maturity from Department of Horticulture, Dapoli. After harvest, fruit were brought to laboratory in plastic crates, each containing 75 fruits. At arrival these fruit were first kept in

walk-in cooler at 13°C for overnight in order to remove field heat. Further, these fruits in the crates, exposed to 1-MCP for 18 hrs in airtight plastic treatment chamber at various concentrations of 1-MCP. After 18 hrs of treatment, these crates were removed from the chamber and were stored under different storage conditions with and without shrink wrapper, for further observations. Physico-chemical properties of Alphonso mango fruit such as TSS, pulp acidity, total sugar,

reducing sugar, vitamin A content and ascorbic acid content, under different storage conditions with and without shrink wrapper was studied by taking out fruit samples at 7, 14, 21 and 26 days after storage for studying the effect of storage and 1-MCP treatments. The organoleptic ratings were assessed by giving the score on the basis of 10 point scale to colour, aroma, flavor, taste and spongy tissue. The treatment are given as follow.

Treatment details:		
Main treatments Factor 1	:	Storage conditions
	i)	S ₁ - Ambient condition (control)
	ii)	S ₂ - Cold storage at 13± 1°C
	iii)	S ₃ – Cold storage 13± 1°C with shrink wrapper
	iv)	S ₄ - Ambient condition with shrink wrapper
Factor 2	:	Concentrations of 1-MCP
	i)	C ₁ - 0 ppb (control)
	ii)	C ₂ - 1000 ppb
	iii)	C ₃ - 2000 ppb
	iv)	C ₄ - 3000 ppb
Replications	:	3 (Three)

Results and Discussions

Effect of 1-MCP under different storage conditions on Physico-chemical properties of Alphonso Mango fruit

Data of pooled mean of two years, pertaining to physico-chemical properties of Alphonso mango fruit as influenced by the 1- MCP treatment under different period of cold storage and shelf life, are presented in the table 1, 2, 3, 4, 5 and 6 and there results are summarized here under:

TSS (°B)

Pooled data (Table 1.) indicated that TSS of the fruit pulp in untreated ambient control increased till 14 DAT and then

decreased with the increase in storage period where as fruits treated with 1- MCP with and without shrink wrapper under cold storage significantly maintained the slow rise in TSS till the end of storage period (26 days). However, numerically maximum TSS of 17.90 °B was recorded in the treatment combination of 2000 ppb of 1-MCP under cold storage at 26 DAT when the fruits kept under ambient conditions were completely spoiled and were unfit for sampling. Similarly Burondkar *et al.* (2013)^[2] also observed considerable delay in ripening of Alphonso mango due to 1-MCP at 1000 ppb without significant differences in total soluble solids between control (17.61°Brix) and in 1-MCP treatments (17.93°Brix).

Table 1: Influence of different concentrations of 1-MCP and storage conditions on total soluble solids (°Brix) at 0, 7, 14, 21 and 26 DAT in Alphonso mango (pooled)

0 DAT						7 DAT					14 DAT				
	C1	C2	C3	C4	Mean	C1	C2	C3	C4	Mean	C1	C2	C3	C4	Mean
S1	8.75	8.56	8.43	8.69	8.61	15.95	14.89	14.85	14.97	15.17	18.81	16.86	15.77	17.64	17.27
S2	8.35	8.56	8.31	8.37	8.40	12.99	11.01	10.81	11.21	11.51	13.74	12.74	12.50	12.80	12.94
S3	8.59	8.67	8.46	8.40	8.53	12.49	11.21	11.21	11.53	11.61	13.78	13.03	12.95	13.25	13.25
S4	8.67	8.81	8.42	8.60	8.62	15.85	14.87	13.56	14.90	14.80	17.94	16.75	14.00	17.46	16.54
Mean	8.59	8.65	8.40	8.51		14.32	13.00	12.61	13.15		16.07	14.85	13.81	15.28	
	S.Em.±	C.D. (1%)				S.Em.±	C.D. (1%)				S.Em.±	C.D. (1%)			
C	0.068	NS				C	0.055	0.208			C	0.015	0.057		
S	0.068	NS				S	0.055	0.156			S	0.015	0.042		
S X C	0.136	NS				S X C	0.110	0.416			S X C	0.030	0.113		

21 DAT						26 DAT				
	C1	C2	C3	C4	Mean	C1	C2	C3	C4	Mean
S1	12.62	15.10	14.95	14.87	14.38	—*	—	—	—	—
S2	16.90	17.49	18.45	17.60	17.61	13.74	16.57	17.90	15.50	15.93
S3	16.60	18.71	18.04	18.81	18.04	13.64	13.90	15.29	13.51	14.09
S4	14.72	15.62	14.91	15.00	15.06	—	—	—	—	—
Mean	15.21	16.73	16.59	16.57						
	S.Em.±	C.D. (1%)								
C	0.016	0.062								
S	0.016	0.046								
S X C	0.033	0.124								

DAT – Days after treatment, —* Data were not recorded since all the fruits were spoiled.

C1: 0 ppb 1-MCP C3: 2000 ppb 1-MCP S1: Ambient storage without 1-MCP S3: Cold storage (13±10C) + 1- MCP + Shrink wrapper

C2: 1000 ppb 1-MCP C4: 3000 ppb 1-MCP S2: Cold storage (13±10C) + 1-MCP S4: Ambient storage + 1-MCP + Shrink wrapper

Pulp acidity (%)

Under different period of storage at 7, 14, 21 and 26 days, the

pooled mean for percent acidity in untreated ambient control fruits decreased gradually from 3.105 % to 0.22 at 21 DAT,

whereas acidity of 1-MCP treated fruits with storage under cold conditions shown minimum loss in acidity with the increasing storage period till 26 DAT (Table 2). The numerically lowest acidity was recorded by untreated ambient control (0.22%) when the concentration of 1000, 2000 and 3000 ppb of 1-MCP under cold storage were near to each

other maintaining the higher values of acidity at 21 DAT (0.54, 0.58 and 0.54 % respectively). Similar slow decrease in titratable acidity under the influence of cold storage and 1-MCP has also been reported in mango by Burondkar *et al.*, (2013)^[2], and Dubery *et al.*, (1984)^[5].

Table 2: Influence of different concentrations of 1-MCP and storage conditions on pulp acidity (%) at 0, 7, 14, 21 and 26 DAT in Alphonso mango (pooled)

0 DAT						7 DAT					14 DAT				
	C1	C2	C3	C4	Mean	C1	C2	C3	C4	Mean	C1	C2	C3	C4	Mean
S1	3.105	3.108	3.145	3.208	3.142	0.950	1.190	1.240	1.100	1.120	0.400	0.460	0.520	0.420	0.450
S2	3.123	3.083	3.113	3.120	3.110	2.550	2.690	3.000	2.640	2.720	1.320	1.600	1.780	1.510	1.553
S3	3.213	3.098	3.133	3.217	3.165	2.480	2.630	2.580	2.600	2.573	1.300	1.420	1.440	1.410	1.393
S4	3.180	3.043	3.162	3.038	3.106	1.097	1.240	1.240	1.120	1.174	0.409	0.520	0.560	0.460	0.487
Mean	3.155	3.083	3.138	3.146		1.769	1.938	2.015	1.865		0.857	1.000	1.075	0.950	
	S.Em.±	C.D. (1%)				S.Em.±	C.D. (1%)				S.Em.±	C.D. (1%)			
C	0.039	NS				C	0.014	0.054			C	0.017	0.065		
S	0.039	NS				S	0.014	0.04			S	0.017	0.049		
S X C	0.079	NS				S X C	0.028	0.108			S X C	0.034	NS		

21 DAT						26 DAT					
	C1	C2	C3	C4	Mean	C1	C2	C3	C4	Mean	
S1	0.22	0.29	0.32	0.24	0.27	—*	—	—	—	—	
S2	0.32	0.54	0.58	0.54	0.50	0.28	0.35	0.38	0.35	0.34	
S3	0.32	0.35	0.48	0.35	0.38	0.22	0.31	0.31	0.31	0.29	
S4	0.24	0.32	0.34	0.27	0.29	—	—	—	—	—	
Mean	0.28	0.38	0.43	0.35							
	S.Em.±	C.D. (1%)									
C	0.009	0.037									
S	0.009	0.027									
S X C	0.019	0.073									

DAT – Days after treatment, —* Data were not recorded since all the fruits were spoiled.

C1: 0 ppb 1-MCP C3: 2000 ppb 1-MCP S1: Ambient storage without 1-MCP S3: Cold storage (13±10C) + 1- MCP + Shrink wrapper

C2: 1000 ppb 1-MCP C4: 3000 ppb 1-MCP S2: Cold storage (13±10C) + 1-MCP S4: Ambient storage + 1- MCP + Shrink wrapper

Reducing sugars (%)

The data of the two years and pooled mean indicated that reducing sugars percentage in the pulp was significantly influenced due to various treatments (Table 3) and shown rise in reducing sugar till its highest peak values and further decline till the end of storage. Among all the treatment combinations, 2000 ppb of 1-MCP under cold storage recorded maximum reducing sugar (4.225 %) at 21 DAT

which was significantly higher over other treatments. Similar effect of cold storage on delaying the sugar metabolism is reported in mango (Burondkar *et al.*, 2013; Rathore *et al.*, 2007; Silva *et al.*, 2004; Santos *et al.*, 2004; Alves *et al.*, 2004; Morais, 2001; Pandey and Singh, 2007; Liu *et al.*, 2010; Coccozza *et al.*, 2004)^[2, 14, 4, 1, 9, 10, 8, 12] and other fruit crops *viz.*, apple (Fan *et al.*, 1999; Jomari *et al.*, 2003; Calvo, 2002)^[6, 7, 3].

Table 3: Influence of different concentrations of 1-MCP and storage conditions on reducing sugars (%) at 0, 7, 14, 21 and 26 DAT in Alphonso mango (pooled)

0 DAT						7 DAT					14 DAT				
	C1	C2	C3	C4	Mean	C1	C2	C3	C4	Mean	C1	C2	C3	C4	Mean
S1	1.285	1.243	1.294	1.328	1.287	3.262	3.023	3.014	3.041	3.085	4.312	3.875	3.628	4.046	3.965
S2	1.250	1.349	1.217	1.245	1.265	2.759	2.450	2.105	2.495	2.452	3.169	2.944	2.890	2.957	2.990
S3	1.254	1.284	1.218	1.246	1.251	2.783	2.495	2.495	2.567	2.585	3.182	3.011	2.991	3.058	3.061
S4	1.294	1.343	1.273	1.287	1.299	3.239	3.019	3.024	3.025	3.077	4.114	3.848	3.232	4.006	3.800
Mean	1.271	1.305	1.251	1.276		3.011	2.747	2.659	2.782		3.694	3.419	3.185	3.517	
	S.Em.±	C.D. (1%)				S.Em.±	C.D. (1%)				S.Em.±	C.D. (1%)			
C	0.025	NS				C	0.012	0.046			C	0.011	0.044		
S	0.025	NS				S	0.012	0.035			S	0.011	0.033		
S X C	0.051	NS				S X C	0.024	0.092			S X C	0.023	0.087		

21 DAT						26 DAT					
	C1	C2	C3	C4	Mean	C1	C2	C3	C4	Mean	
S1	3.875	3.510	3.426	3.458	3.567	—*	—	—	—	—	
S2	4.115	4.045	4.225	4.070	4.114	3.484	3.679	3.717	3.588	3.617	
S3	4.097	4.076	3.435	4.050	3.915	3.379	3.509	3.544	3.495	3.482	
S4	3.422	3.625	3.465	3.485	3.499	—	—	—	—	—	
Mean	3.877	3.814	3.638	3.766							

	S.Em.±	C.D. (1%)							
C	0.018	0.069							
S	0.018	0.052							
S X C	0.036	0.137							

DAT – Days after treatment, —* Data were not recorded since all the fruits were spoiled.

C1: 0 ppb 1-MCP C3: 2000 ppb 1-MCP S1: Ambient storage without 1-MCP S3: Cold storage (13±10C) + 1- MCP + Shrink wrapper
 C2: 1000 ppb 1-MCP C4: 3000 ppb 1-MCP S2: Cold storage (13±10C) + 1-MCP S4: Ambient storage + 1- MCP + Shrink wrapper

Total sugars (%)

Similar to reducing sugars, total sugars percentage was also influenced significantly due to 1-MCP treatment during the two years of investigation. Pooled mean indicated that total sugars content of the pulp under different storage followed the similar trend of total sugars (Table 4). Amongst the combinations of 1-MCP and storage, cold storage with and

without shrink wrapper with all the combinations of 1-MCP shown slow decline till the end of storage period when the fruits under ambient storage were completely spoiled. The good amount of total sugar was recorded in cold storage treatment with 1-MCP of 2000 ppb till 21 and 26 DAT (13.93 % and 12.50 % respectively)

Table 4: Influence of different concentrations of 1-MCP and storage conditions on total sugars (%) at 0, 7, 14, 21 and 26 DAT in Alphonso mango (pooled)

0 DAT						7 DAT					14 DAT				
	C1	C2	C3	C4	Mean	C1	C2	C3	C4	Mean	C1	C2	C3	C4	Mean
S1	2.48	2.64	2.47	2.56	2.54	10.21	9.41	9.38	9.47	9.62	15.04	13.59	12.76	14.16	13.89
S2	2.58	2.54	2.53	2.34	2.50	8.53	7.50	7.35	7.65	7.76	11.23	10.48	10.30	10.53	10.63
S3	2.52	2.63	2.60	2.64	2.60	8.61	7.65	7.65	7.89	7.95	11.28	10.71	10.64	10.86	10.87
S4	2.81	2.70	2.58	2.72	2.70	10.13	9.40	9.42	9.42	9.59	14.38	13.50	11.44	14.02	13.33
Mean	2.59	2.63	2.54	2.57		9.37	8.49	8.45	8.61		12.98	12.07	11.28	12.39	
	S.Em.±	C.D. (1%)					S.Em.±	C.D. (1%)				S.Em.±	C.D. (1%)		
C	0.138	NS				C	0.018	0.07			C	0.018	0.07		
S	0.138	NS				S	0.018	0.05			S	0.018	0.053		
S X C	0.277	NS				S X C	0.037	0.14			S X C	0.037	0.142		

21 DAT						26 DAT				
	C1	C2	C3	C4	Mean	C1	C2	C3	C4	Mean
S1	12.95	11.73	11.62	11.56	11.97	—*	—	—	—	—
S2	13.75	13.52	13.93	13.60	13.70	11.76	12.42	12.50	12.12	12.20
S3	13.69	13.79	12.20	13.63	13.33	11.42	11.82	11.96	11.80	11.75
S4	11.44	12.12	11.58	11.65	11.70	—	—	—	—	—
Mean	12.96	12.79	12.33	12.61						
	S.Em.±	C.D. (1%)								
C	0.026	0.099								
S	0.026	0.079								
S X C	0.052	0.197								

DAT – Days after treatment, —* Data were not recorded since all the fruits were spoiled.

C1: 0 ppb 1-MCP C3: 2000 ppb 1-MCP S1: Ambient storage without 1-MCP S3: Cold storage (13±10C) + 1- MCP + Shrink wrapper
 C2: 1000 ppb 1-MCP C4: 3000 ppb 1-MCP S2: Cold storage (13±10C) + 1-MCP S4: Ambient storage + 1- MCP + Shrink wrapper

Ascorbic acid content (mg / 100 g fr. wt.) and vitamin A (IU) content

It was observed from the data (Table 5 and 6) that 1 -MCP treatment had exerted significant effect on ascorbic acid content as well as vitamin A content of the fruits. The quality assessed fruits shown that the fruits treated with 2000 ppb 1-

MCP and kept under cold storage shown slow increase in vitamin A content whereas reduced loss of ascorbic acid content (75.05 to 58.84 mg / 100 g fr. wt.) from 0 DAT to 26 DAT respectively as compared to ambient control and other treatment combinations. Similar results have been reported by Plotto *et al.* (2003) ^[11].

Table 5: Influence of different concentrations of 1-MCP and storage conditions on vitamin A (IU) content at 0, 7, 14, 21 and 26 DAT in Alphonso mango (pooled)

0 DAT						7 DAT					14 DAT				
	C1	C2	C3	C4	Mean	C1	C2	C3	C4	Mean	C1	C2	C3	C4	Mean
S1	434	436	436	436	435	5197	4523	4368	5191	4820	6679	4903	4802	6127	5628
S2	436	437	435	436	436	1007	903	858	906	919	1594	1306	1264	1331	1374
S3	434	436	437	435	436	1012	971	960	990	983	1596	1382	1345	1455	1445
S4	435	436	437	436	436	5197	4370	4330	5191	4772	6402	4870	4798	5920	5497
Mean	435	436	436	436		3103	2692	2629	3069		4068	3115	3052	3708	
	S.Em.±	C.D. (1%)					S.Em.±	C.D. (1%)				S.Em.±	C.D. (1%)		
C	0.51	NS				C	3.83	14.38			C	3.21	12.05		
S	0.51	NS				S	3.83	10.82			S	3.21	9.07		

S X C	1.03	NS			S X C	7.66	28.76			S X C	6.42	24.10		
21 DAT						26 DAT								
	C1	C2	C3	C4	Mean	C1	C2	C3	C4	Mean				
S1	5668	4827	4802	5247	5136	—*	—	—	—	—				
S2	3744	3302	3302	3305	3413	4292	4114	4113	4117	4159				
S3	3868	3426	3327	3447	3517	4325	4238	4139	4258	4240				
S4	5544	4805	4802	4926	5019	—	—	—	—	—				
Mean	4706	4090	4058	4231										
	S.Em.±	C.D. (1%)												
C	3.01	11.33												
S	3.01	8.53												
S X C	6.03	22.66												

DAT – Days after treatment, —* Data were not recorded since all the fruits were spoiled.

C1: 0 ppb 1-MCP C3: 2000 ppb 1-MCP S1: Ambient storage without 1-MCP S3: Cold storage (13±10C) + 1- MCP + Shrink wrapper
 C2: 1000 ppb 1-MCP C4: 3000 ppb 1-MCP S2: Cold storage (13±10C) + 1-MCP S4: Ambient storage + 1- MCP + Shrink wrapper

Table 6: Influence of different concentrations of 1-MCP and storage conditions on ascorbic acid content (mg / 100 g fr. wt.) at 0, 7, 14, 21 and 26 DAT in Alphonso mango (pooled)

0 DAT						7 DAT					14 DAT				
	C1	C2	C3	C4	Mean	C1	C2	C3	C4	Mean	C1	C2	C3	C4	Mean
S1	76.03	74.64	75.47	75.61	75.44	69.61	70.38	71.01	70.28	70.32	65.39	65.66	66.30	65.57	65.73
S2	75.46	75.35	75.05	75.28	75.28	73.93	74.34	74.37	74.32	74.24	68.22	70.65	70.78	69.54	69.80
S3	75.25	76.28	76.00	76.50	76.01	73.86	74.02	74.14	73.97	73.99	67.66	69.42	69.45	69.10	68.91
S4	75.55	74.95	75.38	76.30	75.54	70.20	70.95	71.93	70.29	70.84	65.49	66.23	67.22	65.58	66.13
Mean	75.57	75.30	75.48	75.92		71.90	72.42	72.86	72.21		66.69	67.99	68.44	67.45	
	S.Em.±	C.D. (1%)				S.Em.±	C.D. (1%)				S.Em.±	C.D. (1%)			
C	0.47	NS				C	0.072	0.27			C	0.079	0.298		
S	0.47	NS				S	0.072	0.20			S	0.079	0.225		
S X C	0.94	NS				S X C	0.144	0.54			S X C	0.159	0.596		

21 DAT						26 DAT								
	C1	C2	C3	C4	Mean	C1	C2	C3	C4	Mean				
S1	56.46	56.73	57.36	56.64	56.80	—*	—	—	—	—				
S2	64.29	66.72	66.85	65.61	65.87	56.28	58.71	58.84	57.60	57.86				
S3	63.73	65.48	65.52	65.17	64.98	55.72	57.47	57.51	57.16	56.97				
S4	56.55	57.30	58.28	56.65	57.20	—	—	—	—	—				
Mean	60.26	61.56	62.00	61.02										
	S.Em.±	C.D. (1%)												
C	0.080	0.300												
S	0.080	0.230												
S X C	0.160	0.600												

DAT – Days after treatment, —* Data were not recorded since all the fruits were spoiled.

C1: 0 ppb 1-MCP C3: 2000 ppb 1-MCP S1: Ambient storage without 1-MCP S3: Cold storage (13±10C) + 1- MCP + Shrink wrapper
 C2: 1000 ppb 1-MCP C4: 3000 ppb 1-MCP S2: Cold storage (13±10C) + 1-MCP S4: Ambient storage + 1- MCP + Shrink wrapper

▪ **Effect of different 1-MCP concentrations and storage conditions on organoleptic test of fruit**

Data (Table 7) regarding sensory evaluation of fruits based on organoleptic evaluation, in respect of pulp colour, aroma, taste, flavor and spongy tissue, indicated that irrespective of storage time and shelf life, all the 1- MCP treated fruit obtained at par score over control treatment, and none of the treatments obtained score below unacceptable level of 5.

However the minimum score of incidence of spongy tissue (6.40) and maximum score for better colour (7.62) at optimum ripening is observed in treatment combination of 2000 ppb 1-MCP under cold storage. Similarly Coccozza *et al.* (2004)^[4] found that sensory judges detected no difference in aroma, colour or firmness between untreated and 1-MCP treated ‘Tommy Atkins’ mangoes.

Table 7: Influence of different concentrations of 1-MCP and storage conditions on organoleptic evaluation of colour, aroma taste, flavor and spongy tissue at optimum ripening in Alphonso mango (pooled)

Colour						Aroma								
	C1	C2	C3	C4	Mean	C1	C2	C3	C4	Mean				
S ₁	7.25	7.30	7.30	7.28	7.28	7.80	7.86	7.60	7.72	7.74				
S ₂	7.38	7.54	7.62	7.56	7.52	7.75	7.92	7.76	7.88	7.82				
S ₃	7.36	7.52	7.58	7.32	7.44	7.60	7.64	7.75	7.80	7.69				
S ₄	7.27	7.28	7.40	7.32	7.31	7.82	7.82	7.66	7.70	7.75				
Mean	7.31	7.41	7.47	7.37		7.74	7.81	7.69	7.77					

	Taste					Flavour					Spongy tissue				
	C ₁	C ₂	C ₃	C ₄	Mean	C ₁	C ₂	C ₃	C ₄	Mean	C ₁	C ₂	C ₃	C ₄	Mean
S ₁	8.60	7.93	7.90	7.88	8.07	7.20	7.16	7.23	7.24	7.20	7.75	7.70	7.41	7.65	7.62
S ₂	8.00	8.04	8.04	7.92	8.00	7.34	7.34	7.36	7.34	7.34	6.36	6.48	6.40	6.46	6.42
S ₃	8.00	8.02	7.88	7.90	7.95	7.32	7.32	7.32	7.36	7.33	7.70	6.44	6.46	6.43	6.75
S ₄	8.02	7.94	7.96	7.86	7.94	7.22	7.14	7.24	7.20	7.20	7.50	7.32	7.53	7.72	7.51
Mean	8.15	7.98	7.94	7.89		7.27	7.24	7.28	7.28		7.32	6.98	6.95	7.06	

C1: 0 ppb 1-MCP C3: 2000 ppb 1-MCP S1: Ambient storage without 1-MCP S3: Cold storage (13±10C) + 1- MCP + Shrink wrapper
 C2: 1000 ppb 1-MCP C4: 3000 ppb 1-MCP S2: Cold storage (13±10C) + 1-MCP S4: Ambient storage + 1- MCP + Shrink wrapper

Conclusion

In general it is concluded that that the vapour treatment of fruits with 1-MCP, holds a great potential for its commercial use in delaying fruit ripening, prolonging the post-harvest storage and shelf life of Alphonso mangoes under cold storage with significantly better physico-chemical properties even after 26 DAT. The fruit quality assessed at different intervals of storage and shelf life, revealed that, all quality parameters viz. TSS, pulp acidity, reducing sugars, total sugars, ascorbic acid and vitamin A content found to be influenced and improved significantly with 1-MCP treatment up to 21-26 DAT and were comparable with control (14 days) with minimum incidence of occurrence of spongy tissue disorder in Alphonso mango fruit. The organoleptic ratings obtained by 1-MCP treated fruits and the storage under cold conditions at 13 ± 1°C found to be effective in obtaining at par score with the control fruits with negligible change in aroma, taste and flavor with better colour as compared to control treatments.

References

- Alves RE, Filgueiras HAC, Pereira MEC, Coccozza FM, Jorge JT. Post-harvest ripening of 'Tommy Atkins' mangoes on two maturation stages treated with 1-MCP. *Acta Hort.* 2004; 645:627-632.
- Burondkar MM, Jadhav BB, Mane AV, Mote MS. Ripening behaviour storage and quality of 'Alphonso' mangoes as influenced by 1-methylcyclopropene. *Acta Hort.* 2013; 992:597-606.
- Calvo G. Effect of 1-Methylcyclopropene (1-MCP) on pear maturity and quality. 10th International Pear Symposium. 2002, 263-277.
- Coccozza FM, Jorge JT, Alves RE, Filgueiras HAC, Santos D, Pereira MEC. Sensory and physical evaluations of cold stored 'Tommy Atkins' mangoes influenced by 1- MCP and modified atmosphere packaging. *Acta Hort.* 2004, 645.
- Dubery IA, Van Rensburg LJ, Schabort JC. Malic enzyme activity and related biochemical aspects during ripening of γ -irradiated mango fruit. *Phytochem.* 1984; 23:1381-1386.
- Fan X, Blankenship SM, Mattheis JP. 1-Methylcyclopropene Inhibits apple ripening. *J American Soc. Hort. Sci.* 1999; 124:690-695.
- Jomari MLL, Kluge RA, Jacomino AP. Cold storage of 'Tahiti' lime treated with 1-Methylcyclopropene. *Scientia Agricola.* 2003; 60(4):785-788.
- Liu T, Zhang H, Jiang G, Wu F, Qian Z, Jiang HQY. Effect of 1-Methylcyclopropene released from 3-Chloro-2-Methylpropene and Lithium Disopropylamide on quality of harvest mango fruit. *J Food Technol.* 2010; 8(3):106-111.
- Morais PLD. Maturidade para colheita e vita util da manga Tommy Atkins para o Mercado europen, 83 p

(Diss. In Fitoencia), Universidate Federal de Fortaleza, 2001.

- Pandey G, Singh BP. Comparative response of 1-Methylcyclopropene and KMnO₄ on post – harvest behaviour of mango. *Indian J Hort.* 2007; 64(2):123-126.
- Plotto A, Jinhe B, Baldwie EA. Effect of pretreatment of Intact 'Kent' and 'Tommy Atkins' mangoes with ethanol vapor, heat or 1-Methylcyclopropene on quality and shelf life of fresh cut slices. *Pro. Fla. State Hort. Soc.* 2003; 116:394-400.
- Rathore HA, Masud T, Sammi S, Soomro AH. Effect of storage on physico-chemical composition and sensory properties of mango *Mangifera indica* L. variety Dashehari. *Pakistan J Nutr.* 2007; 6(2):143- 148.
- Santos EC, Silva S, Rajane M, Santos NMAF, Siveira IRB, Silva LP, *et al.*, Influence of 1-Methylcyclopropene on ripening and conservation of tree dropped mango fruit cv. Rosa. *Acta Hort.*, 2004; 645:573-580.
- Silva SM, Santos EC, Santos AF, Silveria IRB, Menfonca RMN, Alves RE. Influence of 1-Methylcyclopropene on Post-harvest conservation of Exotic Mango cultivars. *Acta Hort.* 2004; 645:565-572.