J. Indian Soc. Coastal agric. Res. 31(1): 64-67 (2013)

Effect of Potassium Permanganate ($KMnO_4$) on Quality of Mango Fruits cv. Alphonso

S. R. PATANKAR*, RASHMI PATIL, G. N. KORAKE,
C. D. PAWAR and P. C. HALDAVNEKAR

Department of Horticulture, College of Agriculture
Dr. Balasaheb Sawant Konkan Krishi Vidyapeeth
Dapoli - 415 712, Maharashtra

Received: 30.06.2013 Accepted: 28.08.2013

An experiment was conducted in completely randomised design with four treatments viz., T_1 - $KMnO_4$ (1gm) + dry saw dust (fine layer), T_2 - $KMnO_4$ (1gm) + wet saw dust (fine layer), T_3 - $KMnO_4$ (1gm) and T_4 - Control. The Alphonso mango fruits with 85% maturity were harvested in the month of April - May, 2011 and utilized for ripening study at ambient storage (24 to 29ºC, 65 to 78% RH) condition. Among different $KMnO_4$ treatments, T_3 - $KMnO_4$ @ 1gm recorded better T.S.S. (17.83 0Brix), acidity (0.90%), reducing sugar (3.72%), total sugar (11.26%), non-reducing sugar (7.54%), β-carotene (9461.00 µg /100 g of pulp) and significantly more organoleptic score (7.96) with respect to pulp colour, flavour, texture as compared to T_4 (control). Thus, $KMnO_4$ @ 1gm resulted in improved chemical composition and sensory qualities of Alphonso mango fruits.

*(**Key words:** Alphonso, $KMnO_4$, Chemical composition, Sensory evaluation)*

Mango is one of the most popular subtropical fruits and belongs to the climacteric category. Mango is not only delicious, but also has high nutritional value. It is high in β-carotene, a precursor of vitamin A, and is a rich source of vitamin C. Mangoes are mainly consumed fresh. The ripe mangoes are reported to have 73.0 - 86.7% moisture, 0.5 - 1.0% protein, 0.1 - 0.8% fat, 11.6 - 24.3 % carbohydrate, 0.412% calcium, 0.195% phosphorus, 50 ppm iron, 6375 - 20750 μg/100g (β-Carotene) Vitamin A, 50 μg/100 g riboflavin and 6.8 - 38.8 mg/100g ascorbic acid, 12.0 - 23.0 TSS (ºBrix) and 0.12 - 0.38% acidity (Anonymous, 2010). Its ripening is characterized by sharp increase in ethylene production and a respiratory climacteric, followed by a series of biochemical changes. Progression in ripening brings about degradation of cell wall component along with structural changes (Parikh *et al.*, 1990). Fruit softening is accompanied by reduction in the size of hemicellulose, loss of galactose side chains, and solubilisation and depolymerisation of pectin.

The enzymes responsible for softening such as polygalacturonase (P.G.) and pectin methyl esterase (P.M.E.) have been reported to increase during ripening of fruits (Tuker and Grierson, 1987). A treatment which can inhibit the rapid softening of fruits after harvest is of paramount importance to increase the storage life of the fruits. India is the largest producer of mangoes in the world, yet its export is very limited mainly due to its poor shelf life. Fruit softening is partially controlled by ethylene and application of exogenous ethylene to fruit causes faster softening (Abdi *et al.*, 1998). Recently, Potassium permanganate ($KMnO_4$) has been identified as a potent inhibitor of ethylene action and has been shown to prevent ethylene induced effects in tomato, banana, plum, apple at very low concentration (Tan, 2009). The effect of potassium permanganate ($KMnO_4$) on ethylene inhibition varies with varieties, stages of maturity, temperature, concentration and exposure time. Hence, an attempt was made to study the effect of $KMnO_4$ on quality of mango fruits cv. Alphonso.

MATERIALS AND METHODS

The investigation on effect of potassium permanganate ($KMnO_4$) on shelf life and quality of mango fruits cv. Alphonso was undertaken in the Department of Horticulture, College of Agriculture, Dapoli with four treatments viz., T_1 - $KMnO_4$ (1gm) + dry saw dust (fine layer), T_2 - $KMnO_4$ (1gm) + wet saw dust (fine layer), T_3 - $KMnO_4$ (1gm) and T_4 - Control replicated thrice in completely randomized design (CRD). The Alphonso mango fruits with about 85% maturity were harvested in the month of April-May, 2011 and utilized for this study at ambient storage conditions (24 to 29ºC, 65-78% RH). The

*Corresponding author : E-mail: somnathpatankar33@gmail.com

KMnO4 treatment was given after washing of mango fruits in clean water and proper drying. A cotton role with 1 gm of $KMnO_4$ granules was tied at the hole situated on the upper surface of corrugated fibre board (CFB) box with the help of thread. Corrugated fibre board boxes were filled with dry/ wet saw dust (fine layer) and then fruits were kept for further observation at ambient storage condition. The untreated control fruits were not given this treatment.

The mango fruits Cv. Alphonso (Stage 'B' i.e. 85% maturity) were collected on the day of harvest. The required temperature was maintained with the help of ice (ranges from 8ºC-16ºC). Then the fruits were dipped in the water. After fruit dipping the temperature of the water was increased, and that increased temperature was maintained by adding ice in water at subsequent time interval throughout the treatment. The pulp temperature of the fruit was checked with the help of thermometer. The pre-cooling was stopped as soon as the pulp temperature of fruit reached the desired level. The treated fruits were kept for observation in CFB boxes. The weight of selected fruits was recorded at three days interval. The chemical analyses of fruits were also carried out at three days interval. In addition, sensory evaluation of ripe fruits stored at ambient temperature was also performed. The data obtained was analyzed statistically using SAS 9.3 software licensed to Indian Agricultural Statistics Research Institute, Pusa, New Delhi.

RESULTS AND DISCUSSION

The T.S.S. content was insignificant across the treatments at the initial day of storage (Table 1). At 3rd day of storage significantly highest T.S.S. (i.e. 10.67 0Brix) was recorded in T_4 (control). At 15th day of storage, the highest T.S.S. content (21.40 ºBrix) was observed in T_4, while the lowest T.S.S. content was recorded in T1 (17.60 0Brix), which was on par with T_3 [$KMnO_4$ (1gm)]. Higher ethylene production in control fruits might have induced

Table 1. *Effect of $KMnO_4$ treatments on T.S.S. (0Brix) of Alphonso mango fruits*

Treatments	Total soluble solids (^{0}Brix)						Mean
	Days of Storage						
	0	3	6	9	12	15	
T_1	7.82	8.23	10.42	13.18	15.07	17.60	12.05
T_2	7.80	8.30	10.29	13.99	15.73	18.70	12.47
T_3	7.90	8.20	10.32	12.78	14.93	17.83	11.99
T_4	7.97	10.67	12.43	15.42	20.63	21.40	14.75
Mean	7.86	8.85	10.86	13.84	16.59	18.88	12.81
SEm +	0.030	0.049	0.050	0.032	0.127	0.128	
CD at 1%	NS	0.36	0.38	0.24	0.95	0.96	

Table 2. *Effect of $KMnO_4$ treatments on titratable acidity (%) of Alphonso mango fruits*

Treatments	Titratable acidity (%)						Mean
	Days of Storage						
	0	3	6	9	12	15	
T_1	3.52	2.68	2.03	1.58	1.17	0.79	2.35
T_2	3.53	3.00	1.79	1.36	1.15	0.65	2.30
T_3	3.47	2.89	2.10	1.74	1.31	0.90	2.48
T_4	3.57	2.24	1.26	1.22	0.63	0.28	1.84
Mean	3.52	2.70	1.79	1.47	1.06	0.65	2.24
SEm +	0.024	0.100	0.015	0.013	0.015	0.014	
CD at 1%	NS	0.75	0.11	0.10	0.11	0.10	

T_1 [$KMnO_4$ (1gm) + Dry Saw Dust (Fine layer)], T_2 [$KMnO_4$ (1gm) + Wet Saw Dust (Fine layer)], T_3 [$KMnO_4$ (1gm)], T_4 – (Control).

Table 3. *Effect of $KMnO_4$ treatments on reducing sugar (%) of Alphonso mango fruits*

Treatments	Reducing sugar (%)						Mean
	Days of Storage						
	0	3	6	9	12	15	
T_1	1.03	1.12	1.38	1.65	2.41	3.83	1.90
T_2	1.04	1.16	1.39	1.77	2.91	4.45	2.12
T_3	1.08	1.21	1.35	1.44	2.23	3.72	1.84
T_4	1.12	1.38	1.73	2.08	3.57	5.67	2.59
Mean	1.06	1.21	1.46	1.73	2.78	4.41	2.11
SEm +	0.011	0.014	0.010	0.009	0.013	0.026	
CD at 1%	NS	0.10	0.076	0.072	0.10	0.19	

Table 4. *Effect of $KMnO_4$ treatments on total sugars (%) of Alphonso mango fruits*

Treatments	Total sugars (%)						Mean
	Days of Storage						
	0	3	6	9	12	15	
T_1	2.07	2.56	4.20	5.80	9.65	11.58	5.98
T_2	2.07	2.53	4.25	6.32	10.21	12.59	6.33
T_3	2.07	2.49	4.11	5.52	9.30	11.26	5.79
T_4	2.16	2.59	4.44	6.86	10.98	14.31	6.89
Mean	2.09	2.54	4.24	6.12	10.03	12.43	6.24
SEm +	0.013	0.013	0.020	0.011	0.100	0.037	
CD at 1%	NS	NS	0.15	0.086	0.23	0.27	

T_1 [$KMnO_4$ (1gm) + Dry Saw Dust (Fine layer)], T_2 [$KMnO_4$ (1gm) + Wet Saw Dust (Fine layer)], T_3 [$KMnO_4$ (1gm)], T_4 – (Control).

earlier ripening in control fruits than the treated ones. These results match well with Habib Ahmed Khan Rathore (2007) who carried out similar studies with Cvs. Dushehari, Sindhri and Chausa in mango. The increased T.S.S. in control than in $KMnO_4$ treated fruits during ripening was attributed to increased activity of enzymes responsible for hydrolysis of starch to soluble sugars, such as sucrose, fructose and glucose.

The titratable acidity content was observed to be insignificant across the treatments at the initial day of storage (Table 2). At 3rd days storage the highest titratable acidity (3.0%) was recorded in T_2, which was on par with T_1 and T_3, and significantly superior over control. The lowest titratable acidity was recorded in T_4. At 15th day of storage, the highest titratable acidity content was observed in T_3 (0.90%), and was significantly superior over the rest of the treatments. The lowest titratable acidity content was consistently observed in control fruits (T4). Significantly lower acidity recorded in control compared to $KMnO_4$ treated fruits may be due to earlier ripening of control fruits. Briceno *et al.*, (1999) reported similar results in mango Cvs. Keit and Palmar.

At 15th day of storage the highest reducing sugars content was observed in T_4 (5.67%) while the lowest was observed in T_3 (3.72%) which was significantly superior over the rest of the treatments excepting T_1 (Table 3). Similarly at 15th day of storage, the highest total sugars content was recorded in T_4 (14.31%), while the lowest was observed in T_3 (11.26%), which was significantly superior over rest of the treatments (Table 4). It could be noticed from the data that the rise in reducing sugars and total during the ripening could be attributed to the conversion of starch and carbohydrates in to simple sugars. Similar results have already been reported by Gautam (2003) and Habib Ahmed Khan Rathore (2007) in mango.

The β-carotene content in treated as well as control fruits are presented in Table 5. There had been a gradual increase in the β-carotene content in all the treatments including control. At 15th day

Table 5. *Effect of $KMnO_4$ treatment on β-carotene (μg/ 100g of pulp) of Alphonso mango fruits*

Treatments	β-carotene (μg/100g of pulp)						Mean
	Days of Storage						
	0	3	6	9	12	15	
T_1	753.00	1504.00	3618.33	5286.67	7042.00	9461.00	4610.83
T_2	757.33	1541.67	3597.67	5251.33	7039.33	10746.67	4822.33
T_3	752.33	1498.67	3515.00	5113.00	6980.67	9461.00	4553.45
T_4	758.67	1745.00	3713.67	5352.67	7206.00	10700.00	4912.67
Mean	755.33	1572.33	3611.16	5250.91	7067	10092.17	4724.82
SEm +	0.94	33.18	29.00	20.70	19.87	115.79	
CD at 1%	NS	NS	NS	156.94	148.7	866.47	

Table 6. *Effect of $KMnO_4$ treatments on sensory qualities of Alphonso mango fruits*

Treatments	Sensory Score			Mean
	Pulp colour	Flavor	Texture	
T_1	7.76	7.72	7.81	7.76
T_2	7.76	7.66	7.51	7.64
T_3	8.14	7.79	7.94	7.96
T_4	7.55	7.18	7.49	7.41
Average	7.80	7.58	7.68	7.69
SEm +	0.038	0.034	0.037	
CD at 1%	0.28	0.25	0.28	

T_1 [$KMnO_4$ (1gm) + Dry Saw Dust (Fine layer)], T_2 [$KMnO_4$ (1gm) + Wet Saw Dust (Fine layer)], T_3 [$KMnO_4$ (1gm)], T_4 – (Control)

of storage lowest β-carotene content was recorded in T_3, while significantly highest β-carotene content was recorded in T_2, and was on par with control treatment T_4. These results are in corroboration with Patil (2003). The $KMnO_4$ (T_3) treated fruits registered highest average sensory score (7.96) as compared to other treatments with the lowest was in the control fruits (Table 6).

REFERENCES

Abdi, N., Mcglasson, W. B., Holford, P., Williams, M., and Mizrahi, Y. (1998). Responses of climacteric and suppressed climacteric plums to treatment with propylene and 1-methylcyclopropene. *Postharvest Biology and Technology* **14**: 29-39.

Anonymous (2010). USDA National Nutrients Database for Standard Reference, Release. 23.

Briceno, S., Zambrano, J. and Castellanos, E. (1999). Delaying fruit ripening in mango cultivars Keit and Palmar using the mixtures vermiculite $KMnO_4$ and silica gel - $KMnO_4$. *Agronomica Trop.*, **49**(1): 41-49.

Gautam, S. K. (2003). I. Post harvest changes in mango Cv. Kesar. II. Effect of various post harvest treatments on chemical attributes. *Indian Journal of Horticulture* **68**(1): 264-269.

Habib Ahmed Khan Rathore (2007). Effect of surface coating and packaging on the keeping quality of mango (*Mangifera indica* L.). *Handling, Transport, Storage and Protection of Plant Products Q80– Packaging*. J(11): 35 (Volume No).

Patil, S. A. (2003). Evaluation of mango (*Mangifera indica* L.) cvs. Alphonso, Ratna, Pairi and Kesar fruits for physico-chemical composition and processing. *M.Sc. Thesis*, Konkan Krishi Vidyapeeth, Dapoli, Dist. Ratnagiri (M.S.).

Parikh, H. R., Nair, G. M. and Modi, V. V. (1990). Some structural changes during ripening of mangoes (*Mangifera indica* L.) cv. Alphonso by abscissic acid treatment. *Annals of Botany* **65**:121-127.

Tan, Y. M. (2009). Effect of ethylene absorber, and temperature on banana shelf life. FASM, University Malaysia Terengganu LP 35 FASM2.