

## Effects of Various Cleaning Agents on Ripening Pattern and Shelf Life of Mango (*Mangifera indica* L.) Fruits cv. Alphonso Under Ambient Conditions

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**Abstract:** An experiment was conducted in the Department of Horticulture, college of Agriculture, Dr. Balasaheb Sawant Konkan Krishi Vidyapeeth, Dapoli (M.S.), India to study the effects of various cleaning agents on quality and shelf life of mango fruits cv. Alphonso under ambient temperature conditions. The experiment was laid out in completely randomized block design having nine treatments viz. T<sub>1</sub>-Teepol (0.1%), T<sub>2</sub>-Carbendazim (500 ppm), T<sub>3</sub>-Sodium Hypochlorite (25 ppm), T<sub>4</sub>-Sodium Hypochlorite (50 ppm), T<sub>5</sub>-Potassium Metabisulphite (75 ppm), T<sub>6</sub>-Potassium Metabisulphite (100 ppm), T<sub>7</sub>-Potassium Metabisulphite (125 ppm), T<sub>8</sub>-Dry brushing and T<sub>9</sub>-Control (No cleaning) with three replications three times. The results revealed that the treatments T<sub>7</sub> i.e. cleaning of fruits with Potassium Metabisulphite @ 125 ppm for 5 minutes proved to be beneficial in controlling stem end rot and anthracnose and T<sub>6</sub> i.e. cleaning of fruit with Potassium Metabisulphite @ 125 ppm for 5 minutes recorded highest sensory quality. Further, it was evident that cleaning of fruits with all disinfectants increases the shelf life by 3 days as compared to dry brushing and control fruits. The present study concluded that cleaning of mango fruit with disinfectants improves increased shelf life as well as quality of Alphonso mango fruits during ripening at ambient conditions.

**Keywords:** Alphonso mango, cleaning agents, sensory quality, shelf life, spongy tissue.

### INTRODUCTION

Alphonso is one of the premium variety mango (*Mangifera indica* L.) in India and has good export potential. Konkan is the major and famous mango producing region in India situated on the west coast of Maharashtra. It is grown on 1, 85,000 ha area in this region which is about 10 per cent of the total area under mango in the whole country. Out of this almost 90 per cent area is under Alphonso. The warm and humid climate, high rainfall (3000-4000 mm), well drained lateritic soils and rain free season from November to May are ideal for production of Alphonso mango in particular. The demand of this

variety is increasing day by day in the domestic as well as export trade. Being highly perishable commodity the post harvest losses in mangoes are about 28-30 per cent (Arya, 2004) [1]. The major causes for post harvest losses are infection by pathogens, improper harvesting and post harvest handling, unhygienic storage conditions and improper mode of transportation.

The export share of Alphonso mango is less than 10 per cent of its production because of occurrence of spongy tissue and the losses during post harvest management. In recent years, emphasis is being given on various means for extending the

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shelf life so that the produce will reach to consumers over an extending period of time without any loss in quality. Carbendazim is the recommended disinfectant but its use is restricted or banned in many importing countries. In view of this, the present study was undertaken to study the effects of various cleaning agents on ripening pattern and shelf life of Alphonso mango under ambient conditions.

## MATERIAL AND METHODS

An experiment was conducted in the Department of Horticulture, College of Agriculture, Dr. B.S. Konkan Krishi Vidyapeeth, Dapoli during 2010-11 by completely randomized design having nine treatments for cleaning of mango fruits *viz.* T<sub>1</sub>-Teepol (0.1%), T<sub>2</sub>-Carbendazim (500 ppm), T<sub>3</sub>-Sodium Hypochlorite (25 ppm), T<sub>4</sub>-Sodium Hypochlorite (50 ppm), T<sub>5</sub>-Potassium Metabisulphite (75 ppm), T<sub>6</sub>-Potassium Metabisulphite (100 ppm), T<sub>7</sub>-Potassium Metabisulphite (125 ppm), T<sub>8</sub>-Dry brushing and T<sub>9</sub>-Control (No cleaning) which were replicated three times. Thirty fruits per treatment per replication were used for study. In this study, the Alphonso mango fruits harvested at 85 per cent maturity were subjected to different concentrations of cleaning agents and the physico-chemical changes in ripening behaviour under ambient temperature were recorded.

The parameters such as physiological loss in weight (PLW), per cent incidence of spongy tissue, spoilage and shelf life, disease incidence, ripening behaviour of fruits and sensory quality etc were

recorded during investigation. To record the ripening pattern, the fruits were grouped into various categories *viz.*, green (harvesting stage), turning (when a slight tinge of yellow colour appeared on the skin), half ripe (when 50 per cent of fruit peel turned yellow), ripe (when fruit fully turned yellow) and over ripe (when the fruit peel colour turns orange yellow). The data were analyzed statistically as per the statistical methods suggested by Panse and Sukhatme (1985) [6] using CRD and valid conclusions were drawn only on significant differences between treatment mean at 0.01% level of significance.

## RESULTS AND DISCUSSION

### Ripening Behaviour of Mango Fruits

All cleaning treatments required longer time for ripening as compared to control (Table 1). In general, the first visible symptom of initiation of ripening was manifested in the form of change in colour from dark green to light green. Yellow was the next stage with softening of peel which was noticed on 9<sup>th</sup> days and fruit remained firm for another 3 days. In treated fruits, complete ripening was observed on 9 days while decaying started 9 days after harvest. At 12<sup>th</sup> day after harvest, the varying percentage of ripe fruits were recorded and the figures in descending order were as follows T<sub>5</sub> (42.20%), T<sub>6</sub> (42.20%), T<sub>4</sub> (45.60%), T<sub>7</sub> (51.10%), T<sub>9</sub> (51.10%), T<sub>8</sub> (53.33%), T<sub>3</sub> (55.60%), T<sub>2</sub> (56.70%) and T<sub>1</sub> (57.80%). It can be concluded that cleaning of fruits with disinfectants increases the shelf life of mango fruits by 3 days as compared to dry brushing and control fruits. Further among the cleaning treatments, all the cleaning treatments except that with potassium metabisulphite @ 125mg/litre of water showed less shelf life. The findings are in accordance with observations reported by Josh and Roy (1985) [3] in Alphonso mango.

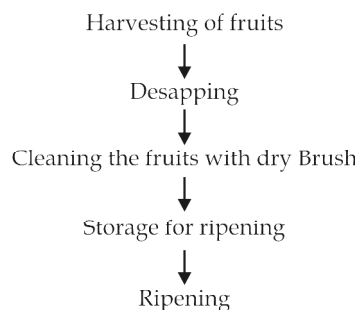
### Physiological Loss in Weight

There was continuous decrease in physiological loss in weight (PLW) till the end of storage life (Table 3). No significant difference between the treatments with respect to PLW up to 12<sup>th</sup> days from harvest. The PLW ranged from 1.39 per cent in (T<sub>1</sub>) to

Flow Chart I  
(For treatments T to T)



Flow Chart II  
(For treatment T)



**Table 1**  
**Ripening percentage of mango cv. Alphonso as affected by various cleaning treatments**

Treatments	Days after harvest										Treatments	Days after harvest													
	0	3	6	9	12	15	T <sub>2</sub>	0	3	6		9	12	15	T <sub>3</sub>	0	3	6	9	12	15	0	3	6	9
T <sub>1</sub> Ripening	0	0	0	0	0	0	T <sub>2</sub>	0	0	0	0	0	T <sub>3</sub>	0	0	0	0	0	0	0	0	0	0	0	0
Green	100	95.6	50	0	0	0	100	100	94.4	64.4	0	0	100	100	94.4	52.2	0	0	0	0	0	0	0	0	0
Turning	0	4.44	40	8.89	0	0	0	0	5.56	26.7	7.78	0	0	0	5.56	35.6	8.89	0	0	0	0	0	0	0	0
Half ripe	0	0	10	24.4	0	0	0	0	0	8.89	27.8	0	0	0	0	12.2	14.4	2.22	0	0	0	0	0	0	0
Ripe	0	0	0	57.8	24.4	0	0	0	0	0	56.7	24.4	4.44	0	0	0	55.6	24.4	4.44	0	0	0	0	0	0
Over ripe	0	0	0	4.44	64.4	80	0	0	0	0	5.56	64.4	75.6	0	0	0	13.3	61.1	75.6	0	0	0	0	0	0
Spoilage	0	0	0	4.44	11.1	20	0	0	0	0	2.22	11.1	20	0	0	0	7.78	12.2	20	0	0	0	0	0	0
Total	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
T <sub>4</sub> Green	100	95.6	52.2	0	0	0	T <sub>5</sub>	100	98.9	47.8	0	0	T <sub>6</sub>	100	98.9	58.9	0	0	0	0	0	0	0	0	0
Turning	0	4.44	37.8	14.4	0	0	0	0	1.11	36.7	16.7	0	0	0	1.11	34.4	13.3	0	0	0	0	0	0	0	0
Half ripe	0	0	10	31.1	0	0	0	0	0	15.6	35.6	0	0	0	0	6.67	38.9	0	0	0	0	0	0	0	0
Ripe	0	0	0	45.6	21.1	4.44	0	0	0	0	42.2	31.1	18.9	0	0	0	42.2	32.2	16.7	0	0	0	0	0	0
Over ripe	0	0	0	6.67	67.8	77.8	0	0	0	0	1.11	60	66.7	0	0	0	3.33	60	67.8	0	0	0	0	0	0
Spoilage	0	0	0	2.22	11.1	17.8	0	0	0	0	4.44	8.89	14.4	0	0	0	2.22	7.78	15.6	0	0	0	0	0	0
Total	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
T <sub>7</sub> Green	100	97.8	46.7	0	0	0	T <sub>8</sub>	100	86.7	23.3	0	0	T <sub>9</sub> (control)	100	81.1	25.6	0	0	0	0	0	0	0	0	0
Turning	0	2.22	41.1	15.6	0	0	0	0	13.3	20	0	0	0	18.9	25.6	0	0	0	0	0	0	0	0	0	0
Half ripe	0	0	12.2	33.3	0	0	0	0	0	56.7	15.6	0	0	0	0	48.9	21.1	0	0	0	0	0	0	0	0
Ripe	0	0	0	51.1	33.3	21.1	0	0	0	0	53.3	23.3	0	0	0	0	51.1	21.1	0	0	0	0	0	0	0
Over ripe	0	0	0	0	62.2	67.8	0	0	0	0	20	50	55.6	0	0	0	18.9	57.8	54.4	0	0	0	0	0	0
Spoilage	0	0	0	0	4.44	11.1	0	0	0	0	11.1	26.7	44.4	0	0	0	8.89	21.1	45.6	0	0	0	0	0	0
Total	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100

T<sub>1</sub> : Teepol (0.1%)  
 T<sub>2</sub> : Carbendazim (500 ppm)  
 T<sub>3</sub> : Sodium Hypochlorite (25 ppm)  
 T<sub>4</sub> : Sodium Hypochlorite (50 ppm)  
 T<sub>5</sub> : Potassium Metabisulphite (75 mg/lit)  
 T<sub>6</sub> : Potassium Metabisulphite (100 mg/lit)  
 T<sub>7</sub> : Potassium Metabisulphite (125 mg/lit)  
 T<sub>8</sub> : Dry Brushing  
 T<sub>9</sub> : Control

2.44 per cent in (T<sub>8</sub>) at 3<sup>rd</sup> day after harvest, while on 9<sup>th</sup> day after harvest the PLW ranged from 6.07 per cent in (T<sub>4</sub>) to 9.05 per cent in (T<sub>9</sub>). The PLW on 12<sup>th</sup> day was minimum 9.75 per cent in (T<sub>5</sub>) and maximum 12.00 per cent in (T<sub>9</sub>). However significant difference in PLW observed at 15<sup>th</sup> DAH. The lowest PLW (12.04%) was observed in treatment T<sub>1</sub> while highest 16.11% was noticed in control (T<sub>9</sub>). Thus, the low physiological loss in weight was noticed in treated fruits might be due to cleaning of fruits which lowered down the temperature and microbial count on surface of fruits and helped to slow down the moisture loss and spoilage of mango fruits through respiration and transpiration of fruits.

## Disease Incidence

### Incidence of stem end rot

There was continuous increase in disease incidence till the end of storage life (Table 2). No significant difference observed between different cleaning treatments and control fruits up to 12<sup>th</sup> days from harvest. Significant difference observed at 15 days after harvest. The lowest incidence of stem end rot

(8.89%) was observed in treatment T<sub>7</sub> [Potassium Metabisulphite (125 ppm)]. In dry brushing (T<sub>8</sub>) and control (T<sub>9</sub>) the incidence of stem end rot was maximum 33.33 and 34.44 per cent respectively (Figure 1). It can be opined that cleaning the fruits with dry brushing could not be an option for use of chemical cleaning agent for preventing incidence of stem end rot during the ripening of mango variety Alphonso. The findings were similar to that observed by Huddar *et al.* (1995) [2] in Alphonso, Panhwar (2005) [5], Ritenour and Crisosto (2004) [7], Masalkar *et al.* (2006) [4] in Alphonso mango.

### Incidence of anthracnose

There was no significant difference observed between different cleaning treatments (Table 2). No disease incidence was recorded up to 6<sup>th</sup> day after harvest. On 12<sup>th</sup> days after harvest the range recorded was 0.00 per cent (T<sub>6</sub>) to 10.00 per cent (T<sub>8</sub>). The significant difference observed in the incidence of anthracnose between treated and control fruits at 15 days after harvest (Figure 2). The lowest incidence of anthracnose (2.22%) was observed in treatment T<sub>7</sub> [Potassium Metabisulphite (125 mg/lit)].

**Table 2**  
Effect of various cleaning treatments on per cent incidence of stem end rot, anthracnose, spongy tissue in mango fruits cv. Alphonso

Treatments	Per cent incidence of stem end rot						Per cent incidence of anthracnose						Spongy tissue (%) at the end of 15 day storage
	Days after harvest						Days after harvest						
	At harvest	3	6	9	12	15	At harvest	3	6	9	12	15	
T <sub>1</sub>	0.00	0.00	0.00	3.33	6.67	15.56	0.00	0.00	0.00	1.11	4.44	7.78	4.44
T <sub>2</sub>	0.00	0.00	0.00	1.11	5.56	11.11	0.00	0.00	0.00	1.11	5.56	10.00	3.33
T <sub>3</sub>	0.00	0.00	0.00	5.56	10.00	18.89	0.00	0.00	0.00	2.22	2.22	6.67	3.33
T <sub>4</sub>	0.00	0.00	0.00	2.22	7.78	14.44	0.00	0.00	0.00	0.00	3.33	5.56	1.11
T <sub>5</sub>	0.00	0.00	0.00	2.22	5.56	11.11	0.00	0.00	0.00	2.22	3.33	5.56	1.11
T <sub>6</sub>	0.00	0.00	0.00	2.22	7.78	13.33	0.00	0.00	0.00	0.00	0.00	4.44	3.33
T <sub>7</sub>	0.00	0.00	0.00	0.00	3.33	8.89	0.00	0.00	0.00	0.00	1.11	2.22	2.22
T <sub>8</sub>	0.00	0.00	0.00	6.67	16.67	33.33	0.00	0.00	0.00	4.44	10.00	17.78	5.56
T <sub>9</sub>	0.00	0.00	0.00	6.67	13.33	34.44	0.00	0.00	0.00	2.22	7.78	17.78	6.67
Mean	0	0	0	3.33	8.51	17.9	0	0	0	1.48	4.19	8.64	
S.Em. (±)	0	0	0	1.01	1.32	2.49	0	0	0	0.78	1.55	1.49	
C.D. (P = 0.01)	NS	NS	NS	NS	NS	10.30	NS	NS	NS	NS	NS	6.143	

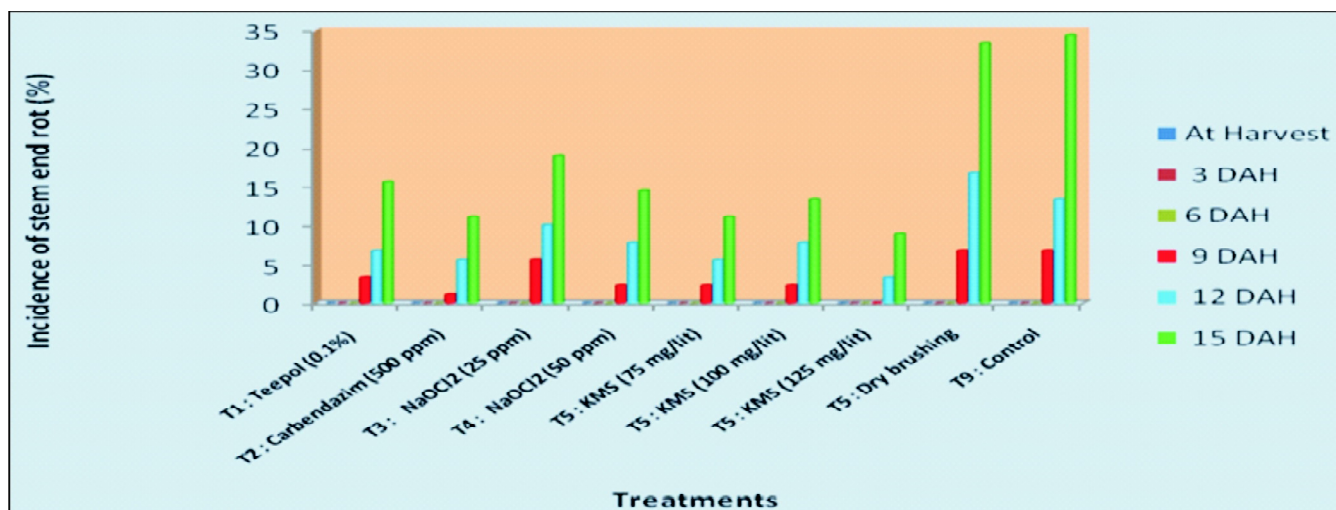


Figure 1: Effect of different cleaning treatments on per cent incidence of Stem End Rot in mango fruits Cv. Alphonso.

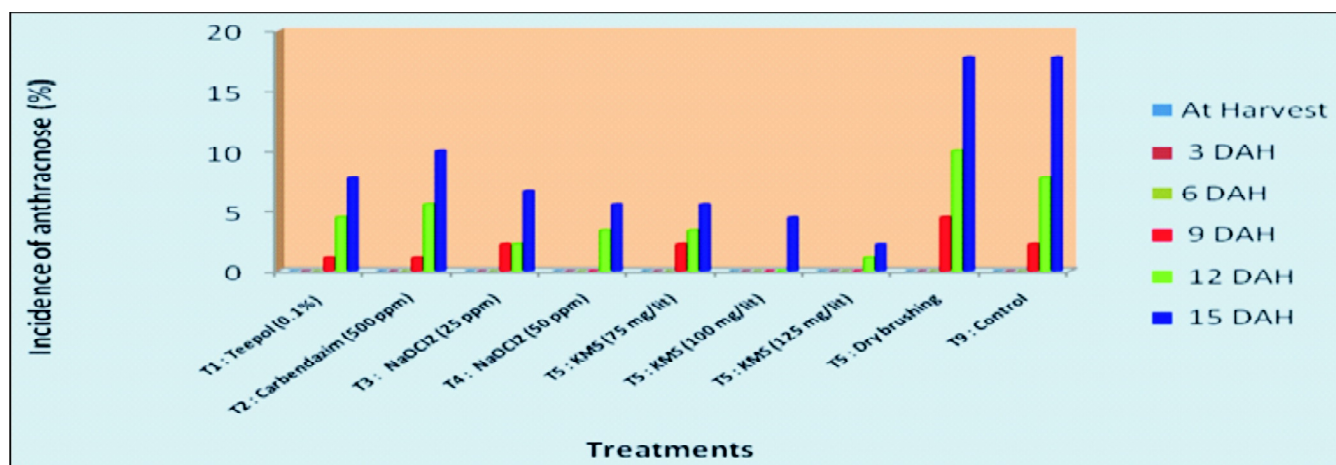


Figure 2: Effect of different cleaning treatments on per cent incidence of Anthracnose in mango fruits Cv. Alphonso.

Better control of anthracnose in treatments of cleaning the fruits with Potassium Metabisulphite and Sodium Hypochlorite may be due to its better disinfecting ability than that of Teepol and carbendazim. The findings were similar to that observed by Huddar *et al.* (1995) [2] in Alphonso, Panhwar (2005) [5], Ritenour and Crisosto (2004) [7], Masalkar *et al.* (2006) [4] in Alphonso mango.

#### Incidence of spongy tissue in mango fruits

The incidence of spongy tissue was comparatively more in treatment T<sub>8</sub> (5.56%) *i.e.* Dry brushing and T<sub>9</sub> (6.67%) *i.e.* control respectively [Table 2]. This may be due to dipping of fruits in aqueous solution which might have helped in performing sort of pre-cooling of fruits. The lowest spongy tissue incidence after ripening was recorded in T<sub>4</sub> and T<sub>5</sub> (1.11%).

#### Sensory quality of mango fruits

Sensory evaluation of Alphonso mango fruits further indicates (Table 3) that fruits treated with potassium metabisulphite (100 ppm) *i.e.*, T<sub>6</sub> (8.00) registered highest average sensory score while treatment T<sub>8</sub> recorded lowest sensory score (6.00).

#### CONCLUSION

An investigation was carried out to study the effects of various cleaning agents on ripening pattern and shelf life of mango (*Mangifera indica* L.) fruits cv. Alphonso under ambient conditions. The results revealed that cleaning with disinfectants improves shelf life of Alphonso mango fruit stored for ripening at ambient conditions by 3 days and their quality was also found to be superior. It also

**Table 3**  
**Effect of various cleaning treatments on Physiological Loss in Weight (%) and organoleptic evaluation score of mango fruits cv. Alphonso**

Treatments	Physiological Loss in Weight (%) of mango fruits						Organoleptic evaluation			
	At harvest	Days after harvest					Colour	Texture	Flavour	Average
		3	6	9	12	15				
T <sub>1</sub>	0.00	1.39	3.24	6.57	9.95	12.04	7.67	8.00	8.00	7.89
T <sub>2</sub>	0.00	1.52	3.65	6.31	9.80	12.11	7.33	7.33	7.00	7.22
T <sub>3</sub>	0.00	1.49	3.72	6.23	10.31	12.85	7.67	7.00	5.67	6.78
T <sub>4</sub>	0.00	1.65	3.57	6.07	10.20	13.84	6.67	5.67	7.67	6.67
T <sub>5</sub>	0.00	1.77	3.85	6.54	9.75	13.39	7.00	7.00	6.67	6.89
T <sub>6</sub>	0.00	1.69	3.70	6.86	10.20	13.65	8.33	8.00	7.67	8.00
T <sub>7</sub>	0.00	1.87	4.24	8.24	11.83	15.33	6.33	6.33	6.33	6.33
T <sub>8</sub>	0.00	2.44	4.42	8.37	11.63	14.83	5.67	6.00	6.33	6.00
T <sub>9</sub>	0.00	2.11	4.93	9.05	12.00	16.11	6.33	7.00	7.33	6.89
Mean	0	1.77	3.92	7.14	10.63	13.79				
S.Em. (±)	0	0.18	0.20	0.395	0.316	0.402				
C.D.(P = 0.01)	NS	NS	NS	NS	NS	1.660				

improves the appearance and attractiveness of Alphonso mango. Hence this can successfully be used for increase quality and shelf life of mango.

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