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EFFECT OF POST HARVEST TREATMENTS ON BLACK SPOTTING, INFESTATION AND ORGANOLEPTIC QUALITY OF AMRAPALI MANGO DURING AMBIENT STORAGE

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Abstract

This experiment was conducted during 2011-12 to study the effect of post harvest hot water treatment and wax coating on occurrence of black spotting and infestation of insects like fruit fly during storage of Amrapali mango fruits under ambient condition. Black spots on fruits skin during ripening and storage are mainly due to the infection of Anthracnose and Stem-end rot are the major post harvest diseases of mango fruits. In the present experiment, fruits were harvested at green mature stage and treated with four post-harvest treatments *viz*. (T_1- Hot water treatment at 52 ± 2^0C for 5 minutes), (T_2- Wax coating of 6% wax emulsion), (T_3- Hot water treatment + Wax coating) and (T_4- water was taken as control). Treated fruits were packed in CFB boxes and stored under ambient condition. Observations were recorded at 3 days intervals during storage. Results revealed that the treatment of HWT + Wax coating was found to be best to minimize the black spotted and infested fruit per cent in mango during storage. Treated fruits retained the maximum fruits firmness and highest organoleptic score with acceptability upto 15 days, while 6 days in untreated fruits during the ambient storage. Treatments of HWT + Wax coating was also improved the shelf life of mango fruits up to 15 days with lowest PLW per cent against only 9 days was recorded in control.

Key words : Amrapali mango, organoleptic quality, ambient storage, hot water treatment and wax coating, disease pest control, black spotted and infested fruits.

Introduction

Mango (*Mangifera indica* L.) unarguably is one of the oldest and choicest tropical fruits of the world and is rightly designated as "King" of all fruits. Besides delicious taste, excellent flavor and attractive fragrance, it is rich in vitamins A & C. Due to highly perishable in nature mango fruits has short shelf life. Several environment condition higher moisture content, soft textures of fruit and susceptibility to various pathogenic infections are also the limiting factors to its shelf life. Only a few varieties *viz*. Alphanso, Kesar etc. are available with better storage life and hence better suited for export. But the production of these cultivars is very limited.

Among the promising mango hybrid Amrapali is one of the most suitable varieties for inter as well as overseas markets and processing industries. It possesses quality par excellence with very high pulp percentage and TSS. The fresh fruit poses deep orange red colour and contains about 2.5-3.0 times more β-carotene content than other commercial varieties. Due to late maturing variety, fruits are harvested in rainy season, resulting excess in fruit loss due to the attack of various disease and insect pest. Anthracnose (*Coletotrichum gloeosporioides*) and Stem-end rot (*Diplododia netalensis*) are the major post harvest diseases of mango fruits, which cause black spots on fruits skin during ripening and storage. Infestation with oriental fruit fly (*Bactocera dorsalis*) has been a major impediment to mango export. It accounts for about 27 per cent of the harvesting loss (Verghese *et al*., 2006). The main bottlenecks associated with this variety are its shorter shelf life and post harvest losses mainly due to anthracnose and fruit fly. These are the major hurdles in the marketing of this very tasty and delicious cultivar in export and domestic markets. It is not only a serious problem of Amrapali growers and traders in India, but present time improvement in the shelf life and reduction in the post harvest losses of mango fruit is an international issue. Other factors like improper harvesting, mishandling, inadequate transportation, storage have also added to post harvest losses. In mango, post harvest losses lie in the range 25-40 per cent from harvesting to consumption stage and reduction in these losses is essential for

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increasing the availability from the existing production. However, loss of this very perishable commodity is a big worth annually.

Hence, the present investigation was formulated with post harvest hot water treatment and wax coating of mango fruits. Hot water treatment has been accepted worldwide as an ideal disease and insect control treatment in mango fruits since it is environmentally safe and non-chemical. Disease and insect attacks coupled with post harvest losses of fruits. Chemical control has been reported to leave residues of the hazard chemicals on the fruits. This poses a significant health risk to the consumer and their use is very much restricted by regulatory bodies. Hot water treatment maintains fruit quality, appearance, prolongs the storage life, develops tolerance to chilling injury during cold storage and kills the pathogens and eggs of fruit fly. It is also relatively easy to use and efficient in heat transfer within a short operating time (Elazar-Fallik, 2004). Edible wax coating is being used on fruits to extend the shelf life and improve appearance. Semi permeable wax coating can create a modified atmosphere similar to controlled atmospheric storage, with less expense incurred. Wax coating also reduces moisture loss, retard ripening, impart gloss and protect the fruit from post harvest diseases and decay loss during storage at ambient temperature. This study was conducted to control of black spotting and infestation of fruit fly in fruits and to improve the shelf life and organoleptic quality of mango fruits with avoid the use of harmful chemicals.

Materials and Methods

The present experiment was conducted at PHT Laboratory of Department of Horticulture, N.D. University of Agriculture & Technology, Kumarganj, Faizabad (U.P.), India during 2011-12. Fruits were harvested at green mature stage by hand with 1.0 cm stalk to escape any damage of fruit in morning hours. Fruits of uniform size and maturity, free from injuries, bruises and blemishes were selected for the experiment. Fruits were washed in running tap water and cleaned with muslin cloth. Fruits were equally divided in four lots of 20 kg fruits and undergone with four post harvest treatments *viz*. hot water treatment at 52 ± 2^0C for 5 minutes ($\mathbf{T_1}$), wax coating of 6% wax emulsion ($\mathbf{T_2}$), hot water treatment at 52 ± 2^0C for 5 minutes + wax coating of 6% wax emulsion ($\mathbf{T_3}$) and control ($\mathbf{T_4}$). First and third lots were treated with hot water treatment at 52 ± 2^0C temperature for 5 minutes in hot water bath. Second lots and third lots (treated with HWT) were treated with the 'NIPRO-FRESH, Mango' brand 6% wax emulsion. Fourth lot was dip in water and taken as control. Treated fruits were packed in corrugated fiber board boxes with the use of news paper as liner. All boxes were tagged as per treatments and stored under ambient condition. Observations were recorded at 3 days intervals up 18 days during the storage by the following methods.

Black spotted fruits (%)

Black spotted fruits were taken and their weight was recorded with the help of physical balance. The per cent of black spotted fruits was calculated by using following formulae:

$$\text{Black spotted fruits (\%)} = \frac{\text{Weight of Black spotted fruits on observation day + weight of previous Black spotted fruits}}{\text{Initial fruits weight}} \times 100$$

Infested fruit (%)

Number of infested fruits was counted and calculated using the following formulae:

$$\text{Infested fruits (\%)} = \frac{\text{Number of infested fruits}}{\text{Number of initial fruits}} \times 100$$

Physiological loss in weight (PLW%)

The physiological loss in weight was recorded with the help of physical balance and calculated by using following standard procedure mentioned in AOAC (2000).

$$\text{Physiological loss in weight (PLW)} = \frac{\text{Initial fruit weight} - \text{Weight of fruit on observation day}}{\text{Initial fruit weight}} \times 100$$

Fruit firmness (Kg/cm^2)

Fruit firmness was determined as reported by Magness and Taylor (1925) with the help of pressure tester by using a 5/16 plunger in Kg/cm^2. Two readings were taken at two opposite sides on the fruit.

Organoleptic evaluation

The organoleptic evaluation for assessing sensory attributes such as peel colour, flesh colour, texture, taste and flavor of the stored fruits were made by using 9 point Hedonic Rating Scale by a panel of eight judges as described by Larmond (1977).

Results and Discussion

The minimum black spotted fruit (1.82%) was recorded in the treatment of HWT + wax coating followed by the treatment of HWT alone, while the maximum black spotted fruits (96.83%) were recorded in control (table 1). Black spotted fruits per cent was significantly increased with storage period, but treatment of HWT + Wax coating and HWT alone markedly controlled the

Table 1 : Effect of post harvest treatments on black spotted fruit (%) during the storage of mango cv. Amrapali.

Treatments	Days of storage						
	3	6	9	12	15	18	Mean
T_1 (HWT)	1.76	1.76	1.76	1.76	6.34	6.34	**3.29**
T_2 (WC)	6.07	17.63	35.07	54.59	71.70	84.67	**45.00**
T_3 (HWT+WC)	1.13	1.13	1.13	1.13	3.21	3.21	**1.82**
T_4 (Control)	80.96	100	100	100	100	100	**96.83**
Mean	**22.48**	**30.13**	**34.49**	**39.37**	**45.31**	**48.55**	**36.72**

	T	D	T×D
S.Em.±	**1.05**	**0.84**	**1.74**
CD at 5%	**3.14**	**2.43**	**5.28**

Table 2 : Effect of post harvest treatments on infested fruits % during storage of mango cv. Amrapali.

Treatments	Mean
T_1 (HWT)	**0.94** (0.97)
T_2 (WC)	**2.52** (1.34)
T_3 (HWT+WC)	**0.00** (0.71)
T_4 (Control)	**6.19** (2.13)
Mean	**2.41** (1.29)
S.Em.±	**0.03**
CD at 5%	**0.08**

Table 3 : Effect of post harvest treatments on physiological loss in weight (PLW %) of mango fruits cv. Amrapali during ambient storage.

Treatments	Days of storage						
	3	6	9	12	15	18	Mean
T_1 (HWT)	2.19	4.57	8.35	12.71	16.81	20.08	**10.79**
T_2 (WC)	1.15	2.69	5.25	7.28	9.26	13.08	**6.45**
T_3 (HWT + WC)	1.01	2.49	5.04	7.01	8.98	12.28	**6.14**
T_4 (Control)	2.34	4.80	8.80	13.18	17.12	20.43	**11.11**
Mean	**1.67**	**3.62**	**6.75**	**10.05**	**13.04**	**16.47**	**8.60**

	T	D	T × D
S.Em.±	**0.13**	**0.05**	**0.13**
CD at 5%	**0.39**	**0.16**	**0.37**

Table 4 : Effect of post harvest treatments on firmness (Kg/cm^2) of mango fruits cv. Amrapali during ambient storage.

Treatments	Days of storage						
	3	6	9	12	15	18	Mean
T_1 (HWT)	8.08	7.57	6.70	5.13	2.74	1.59	**5.30**
T_2 (WC)	8.24	8.00	7.71	6.86	5.97	4.75	**6.92**
T_3 (HWT+WC)	8.31	8.12	7.81	6.95	6.08	4.84	**7.02**
T_4 (Control)	7.99	7.46	6.59	5.02	2.63	1.49	**5.20**
Mean	**8.15**	**7.77**	**7.20**	**5.99**	**4.35**	**3.17**	**6.11**

	T	D	T×D
S.Em.±	**0.03**	**0.05**	**0.09**
CD at 5%	**0.10**	**0.13**	**0.25**

black spotted fruit per cent during the entire period of storage. The present findings substantiate to the earlier reports of Kumah *et al*. (2011).

The treatment of HWT + wax coating was found superior to control the infestation of fruits fly and no any infested fruits was recorded in treated fruits. Treatment of HWT alone was also found effective to control the infestation and showed only 0.94% infested fruits (table 2). However, untreated fruits showed maximum infested fruits per cent (6.19%). Similar results have also been reported by Verghese *et al*. (2006) in mango cv. Banganapalli.

The PLW per cent of mango fruits was significantly increased with the advancement of storage period at ambient temperature. Physiological loss in weight of fruits is mainly due to evaporation of water, respiration and degradation processes occurring during the post harvest handling of fruits (Haard and Salumkhe, 1975). Fruits treated with HWT + wax coating showed the lowest PLW (6.14%) followed by wax coating alone, while the highest PLW was recorded in control (11.11%) during the storage under ambient condition (table 3). Fruits treated with HWT + wax coating showed the lesser rate of increase in PLW of mango fruits over all treatments and showed the shelf life upto 15 days against

Table 5 : Effect of post harvest treatments on organoleptic quality of mango fruits cv. Amrapali during ambient storage.

Treatments	Days of storage						
	3	6	9	12	15	18	Mean
T_1 (HWT)	8.38	8.74	8.51	7.66	6.87	5.37	**7.23**
T_2 (WC)	7.86	8.24	7.99	7.05	6.62	5.03	**7.49**
T_3 (HWT+WC)	8.67	8.99	8.88	8.05	7.40	6.40	**8.06**
T_4 (Control)	7.67	8.03	7.61	6.68	4.28	3.20	**6.24**
Mean	**8.14**	**8.50**	**8.25**	**7.36**	**6.29**	**5.00**	**7.26**

	T	D	T×D
S.Em.±	**0.04**	**0.06**	**0.16**
CD at 5%	**0.12**	**0.16**	**0.45**

9 days of control. The wax forms a thin layer around the fruits that create permeability barriers to moisture migration and possibly for the some gasses like ethylene, oxygen, CO_2 (Hoa *et al*., 2002). Thus, wax coating appeared to reduce the PLW by reducing the transpiration and respiration of fruits. Paull and Chen (2000) also reported that the heat treatments inhibit the biochemical pathways involved in ripening and other processes in many fruit. Similar results to the present finding have also been reported by Figueroa *et al*. (2011) in Ataulfo mango.

Post harvest treatment with HWT + wax coating retained the highest fruits firmness (7.02 Kg/cm^2) followed by wax coating, whereas least fruit firmness was recorded in control (5.20 Kg/cm^2) (table 4). The fruits treated with HWT + wax coating showed slower reduction in fruit firmness followed by wax coating, while maximum reduction was observed in control during the storage. Wax coating of fruits is known to maintain the fruit firmness mainly due to the reduction in enzymatic activity responsible for disorganization of cellular structure. Similarly, wax coating on mango fruits has also been reported to retard the reduction in fruits firmness during the storage at ambient temperature by Roseane *et al*. (2011). Similar result to the present finding has also been reported by Ansari and Feridoon (2008) and Figueroa *et al*. (2011).

The fruits treated with HWT + wax coating was found to be significantly superior in organoleptic quality with highest score (8.06) and rated like very much followed by wax coating and HWT, while control obtained lowest organoleptic score (6.24) during the storage period (table 5). Fruits treated with HWT + wax coating were found acceptable upto 15th day of storage against 6th days of control. Parallel results to the present findings were also previously reported by Anwar *et al*. (2007) in mango and Sindhu *et al*. (2009) in pear fruits.

Conclusion

It is concluded that post harvest treatment with HWT at 52 ± 2^{0}C for 5 minutes + wax coating of 6% wax emulsion was found to be best to control of black spotting and infestation of fruit fly with prolonged shelf life of mango fruits cv. Amrapali. Treated fruits showed the storage life up to 15 days with lowest PLW per cent and highest organoleptic quality against only 9 days was recorded in control under ambient condition. This treatment is environmentally safe, non-chemical and highly cost effective. Therefore, it is suggested to the mango growers and traders for taking a profitable price of mangoes in domestic and export markets.

References

A.O.A.C. (2000). *Official Methods of Analysis*. 17th edition. Assosiation of Official Analytical Chemists, Washington, D.C. USA.

Ansari, N. A. and H. Feridoon (2008). Postharvest application of hot water, fungicide and waxing on the shelf life of Valencia and local orange cv. Siavarz. *Acta Horticulture*, **768** : 271-277.

Anwar, R. and A. U. Malik (2007). Hot water treatments affect ripening, quality and storage of mango (*Mangifera indica* L). *Pak. J. of Agri. Sci.*, **44(21)**.

Figueroa, M. S, W. I. A. Gómez, E. H. Ortiz, J. A. V. Ovando and M. L. A. Anaya (2011). Effect of chitosan coating on some characteristics of mango (*Mangifera indica* L.) "Ataulfo" subjected to hydrothermal process. *African Journal of Agricultural Research*, **6(27)** : 5800-5807.

Haard, N. F. and D. K. Salunkhe (1975). Symposium on pest biology and handling of fruits and vegetables. *The AVI Publishing Co*.

Hoa, T. T., M. Ducamp and E. A. Baldwin (2002). Effect of different coating treatments on the quality of mango fruits. *J. Food Qual*., **25(6)** : 471-486.

Kumah, Patrick, Appiah Francis and K. John (2011). Effect of hot water treatment on quality and shelf-life of Keitt mango. http://www.scihub.org/ABJNA

Larmond, E. (1977). Laboratory method for sensory evaluation of foods. *Canada Dept. Agri. Pub*., p. 1637.

Paull, R. E. and N. J. Chen (2000). Heat treatment and fruit ripening. *Postharvest Biol. Technol.*, **21** : 21–38.

Roseane, P. A., R. A. M. Maria, M. P. L. Álvaro, L. M. José, A. M. Renato and E. F. Joaquim (2011). Effect of a Galactomannan Coating on Mango Postharvest Physicochemical Quality Parameters and Physiology. *Fruits*, **66(4)** : 269-278

Sindhu, G. S., W. S. Dhillon and B. V. S. Mahajan (2009). Effect of waxing and packaging on pear cv. Punjab Beauty. *Indian J. Hort*., **66(2)** : 239-244.

Verghese, Abraham, K. Sreedevi and D. K. Nagaraju (2006). Pre and post harvest IPM for the mango fruit fly, *Bactrocera dorsalis* (Hendel). Fruit Flies of Economic Importance : From Basic to Applied Knowledge Proceedings of the 7th International Symposium on Fruit Flies of Economic Importance 10-15 September 2006, Salvador, Brazil pp. 179-182.

Elazar, Fallik (2004). Prestorage hot water treatments (immersion, rinsing and brushing). *Postharvest Biology and Technology*, **32** : 125–134.

Magness, J. R. and C. F. Taylor (1925). An improved type of pressure tester 789 for the determination of fruit maturity. U.S. Dept. Agric. Circ. No. 350, p. 8.