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INFLUENCE OF ECO-FRIENDLY POST HARVEST TREATMENTS ON PULP CHROMA AND HUE ON MANGO CV. ALPHONSO FRUITS

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ABSTRACT
The effect of post-harvest treatments on instrumental chroma value and hue angle of mango (cv. Alphonso) fruit pulp was studied. Green and mature mango cv. Alphonso fruits were subjected to various prestorage treatments *viz.,* hot water, chitosan, *Aloe vera* gel, salicylic acid, boric acid and azoxystrobin, *Solanum nigrum* leaf extract and *Trichoderma harzianum*. The fruits were surface dried and placed in corrugated fibre board boxes and cold stored (13 ± 1ºC) for 4 weeks and in ambient condition for 1 week. The treated mango fruits did not alter much chroma and hue angle values as compared to untreated fruits throughout the storage period. Mango fruits dipped in hot water for 50-55°C for 5 minutes recorded minimum changes in C* (45.68) followed by 1 % chitosan treatment for 1 minute (48.01) as compared with control (62.01) after 28 + 7 days of storage. Similarly, a minimum change in *h*° (10.22) was in chitosan treatment. In conclusion, hot water and chitosan treatments were effective in maintaining the pulp color, indicating the reduced ripening process and extended storage life of mango cv. Alphonso fruits.

INTRODUCTION

Mango (*Mangifera indic*a L.) is one of the most important and choicest fruit crop in India having a great cultural, socio-economic and religious significance since ancient times. Owing to its origin in Indo-Burma (Myanmar) region, possessing delicious fruit quality with richness in vitamins and minerals, accessibility to common man, liking by the masses and coverage of large area under cultivation ranging from near coastal areas to the Himalayan foot hills, mango has assigned the status of the 'King of the fruits' in India. Mango being a climacteric fruit, often harvested at the mature, hard green pre-climacteric stage which undergoes numerous biochemical changes during ripening within 9-12 days at ambient temperature (Anju *et al.*, 2014). The beneficial effects of pre-storage hot water treatments were studied by many workers including in ber (Shalini *et al.,* 2014). Alphonso is one of the important cultivar which is a mid-season variety, bearing medium sized fruits (225 g) which are firm and fibreless. Fruit quality is excellent with good sugar and acid blend. It is an expensive and export quality cultivar of India and is mainly grown in Ratnagiri district of Maharashtra, Dharwad and Belgaum transitional belt of Karnataka and in Gujarat (Pandey and Dinesh, 2010). The colour change of mango is a reliable parameter to determine the extent of fruit ripening (Ninio *et al.*, 2003) and is beneficial in assessing the extent of ripening in this study. Hue angle in the case of ripening of mango fruit indicates how yellow (90º) or green (180º) a fruit is, and chroma describe the vividness to dullness of the color (Jeong *et al.*, 2003 and Lo´pez and Go´mez, 2004). Therefore, a detailed study on this aspect was undertaken to access the relationship between the colour change and extent of ripening of mango (cv. Alphonso) fruits at the end of 4 weeks of cold storage (13 ± 1ºC) and subsequently after 1 week of ambient storage. Owing to lack of information on appropriate postharvest treatments and storage environments, the fruits not only lose their quality but also encounter a substantial postharvest loss. The research efforts has helped to increase the production of mango fruit but the purpose of obtaining maximum profit will not be served unless the increased production is supplemented with similar efforts to minimize their postharvest losses which is to the extent of 34 per cent (Sarkar *et al.*, 2011). Therefore, a detailed study on this aspect was undertaken to delay the ripening changes after harvesting of fruits.

MATERIALS AND METHODS

The mature fruits of mango cv. Alphonso were harvested early in the morning and brought to the Department of Post Harvest Technology, Arabhavi. The healthy fruits were pre-cooled in cold storage at 13 ± 1ºC for twelve hours and fruits were thoroughly washed in 0.2 per cent sodium hypochlorite solution for 5 minutes to remove the surface microbial load and dirt adhered to the fruit surface and air dried to remove the surface moisture. These fruits were then subjected to the following ten postharvest treatments viz., T_1: Control (untreated fruits), T_2: Hot water dip (50-55°C) for 5 minutes, T_3: Nipro Fresh wax (10%) for 1 minute, T_4: Chitosan (1%) for 1 minute, T_5: Salicylic acid (0.2%) for 10 minutes, T_6: Boric acid (1%) for 5 minutes, T_7: Azoxistrobin (0.1%) for 5 minutes, T_8: *Aloe vera* gel (1:6 - Gel: Distilled water) for 5 minutes, T_9: *Solanum*

Table 1: Effect of postharvest treatments on chroma (*C) of Mango (cv. Alphonso) fruit pulp stored under cold (13 ± 1°C, 28 days) and ambient conditions (7 days). Means followed by different letters within the column are significantly different at the 5% level**

Treatments	Chroma (*C**) Storage (Days)		Mean
	28	28 + 7	
T_1- Control	46.88^{ab}	62.01^{a}	54.45^{ab}
T_2- Hot water dip (50-55ºC) for 5 minutes	42.59^{cd}	45.68^{c}	44.14^{d}
T_3- Nipro Fresh wax (10%) for 1 minute	43.85^{bc}	50.17^{b}	47.01^{c}
T_4- Chitosan (1%) for 1 minute	44.68^{abc}	48.35^{bc}	46.52^{cd}
T_5- Salicylic acid (0.2%) for 10 minutes	43.06^{cd}	61.19^{a}	52.13^{b}
T_6- Boric acid (1%) for 5 minutes	44.57^{abc}	62.12^{a}	53.35^{ab}
T_7- Azoxystrobin (0.1%) for 5 minutes	40.35^{d}	63.79^{a}	52.07^{b}
T_8- *Aloe vera* gel (1:6 - Gel: Distilled water) for 5 minutes	45.52^{abc}	63.48^{a}	54.50^{ab}
T_9- *Solanum nigrum* leaf extract (20%) for 5 minutes	47.30^{a}	63.17^{a}	55.24^{a}
T_{10}-*Trichoderma harzianum* (10g/l) for 5 minutes	44.14^{abc}	62.98^{a}	53.56^{ab}
Mean	44.29	58.29	51.29
S.Em ±	1.12	1.27	1.20
C.D @ 5%	3.32	3.75	3.38

Table 2: Effect of postharvest treatments on hue (*h*º) angle value of Mango fruit (cv. Alphonso) pulp stored under cold (13 ± 1°C, 28 days) and ambient conditions (7 days). Means followed by different letters within the column are significantly different at the 5% level

Treatments	Hue (*h*º)angle Storage (Days)		Mean
	28	28 + 7	
T_1- Control	74.05	73.92^{ab}	73.99^{ab}
T_2- Hot water dip (50-55ºC) for 5 minutes	73.65	73.72^{abc}	73.69^{ab}
T_3- Nipro Fresh wax (10%) for 1 minute	73.34	72.81^{bc}	73.08^{b}
T_4- Chitosan (1%) for 1 minute	72.59	70.22^{d}	71.41^{c}
T_5- Salicylic acid (0.2%) for 10 minutes	74.13	73.74^{abc}	73.94^{ab}
T_6- Boric acid (1%) for 5 minutes	74.48	73.69^{abc}	74.09^{ab}
T_7- Azoxystrobin (0.1%) for 5 minutes	75.21	74.13^{a}	74.67^{a}
T_8- *Aloe vera* gel (1:6 - Gel: Distilled water) for 5 minutes	73.61	74.04^{ab}	73.83^{ab}
T_9- *Solanum nigrum* leaf extract (20%) for 5 minutes	73.51	74.18^{a}	73.85^{ab}
T_{10}-*Trichoderma harzianum* (10g/l) for 5 minutes	74.47	72.57^{c}	73.52^{b}
Mean	73.90	73.30	73.60
S.Em ±	-	0.44	0.46
C.D. @ 5%	NS	1.30	1.30

nigrum leaf extract (20%) for 5 minutes and T_{10}: *Trichoderma harzianum* (10g/l) for 5 minutes. After imposition of the dip treatments detailed above, the fruits were surface dried and were packed in the CFB boxes. Each treatment consisted of 24 fruits and was replicated thrice. Thus, there were 24 fruits in each box packed in 2 layers. All the boxes were then stored in cold storage maintained at 13 ± 1°C for 28 days. At the end of 28 days of cold storage, the fruits were taken out from the cold room and held at room temperature for 7 days. The instrumental analysis of pulp colour was done once at the end of cold (after 4 weeks) and at the end of ambient storage of 1 week.

The colour of the samples was measured using a Lovibond colour meter (Lovibond RT300, Portable spectrophotometer, The Tintometer Limited, Salisbury, UK) fitted with 8 mm diameter aperture and the instrument was adjusted at 10° observer and D65 primary illuminant. The instrument was calibrated using the black and white tiles provided. Colour was expressed in Lovibond units *C** (chroma) and *h*º angle (hue). Mango fruit pulp was directly placed under the aperture of the colour meter. Two measurements were performed on opposite side of the each sample and the values were averaged.

RESULTS

Chroma (*C**)

The application of postharvest treatments on mango fruits were able to reduce the ripening process subsequently showing reduced colour change with respect to chroma and hue angle parameter. After 28 days of cold storage, the maximum *C** value was found in the treatment, T_9 (47.30) and it was on par with T_1 (46.88), T_4 (44.68), T_6 (44.57), T_8 (45.52) and T_{10} (44.14). The minimum *C** value was associated with the treatment T_7 (40.35) which was not found to differ significantly with T_5 (43.06) and T_2 (42.59). At the end of ambient storage, the treatments T_1 (62.01), T_5 (61.19), T_6 (62.12), T_7 (63.79), T_8 (63.48), T_9 (63.17) and T_{10} (62.98) showed significantly higher *C** value. Lower *C** value during this observation was found in T_2 (45.68) and it was non-significantly followed by T_4 (48.35) (Table 1). Figure 1 indicates the visual peel and pulp colour changes in mango cv. Alphonso fruits during storage.

Hue angle (*h*º)

There was a decreasing trend with respect to hue angle values throughout the experimental period. There was no significant difference in *h*º angle after 28 days of cold storage among the

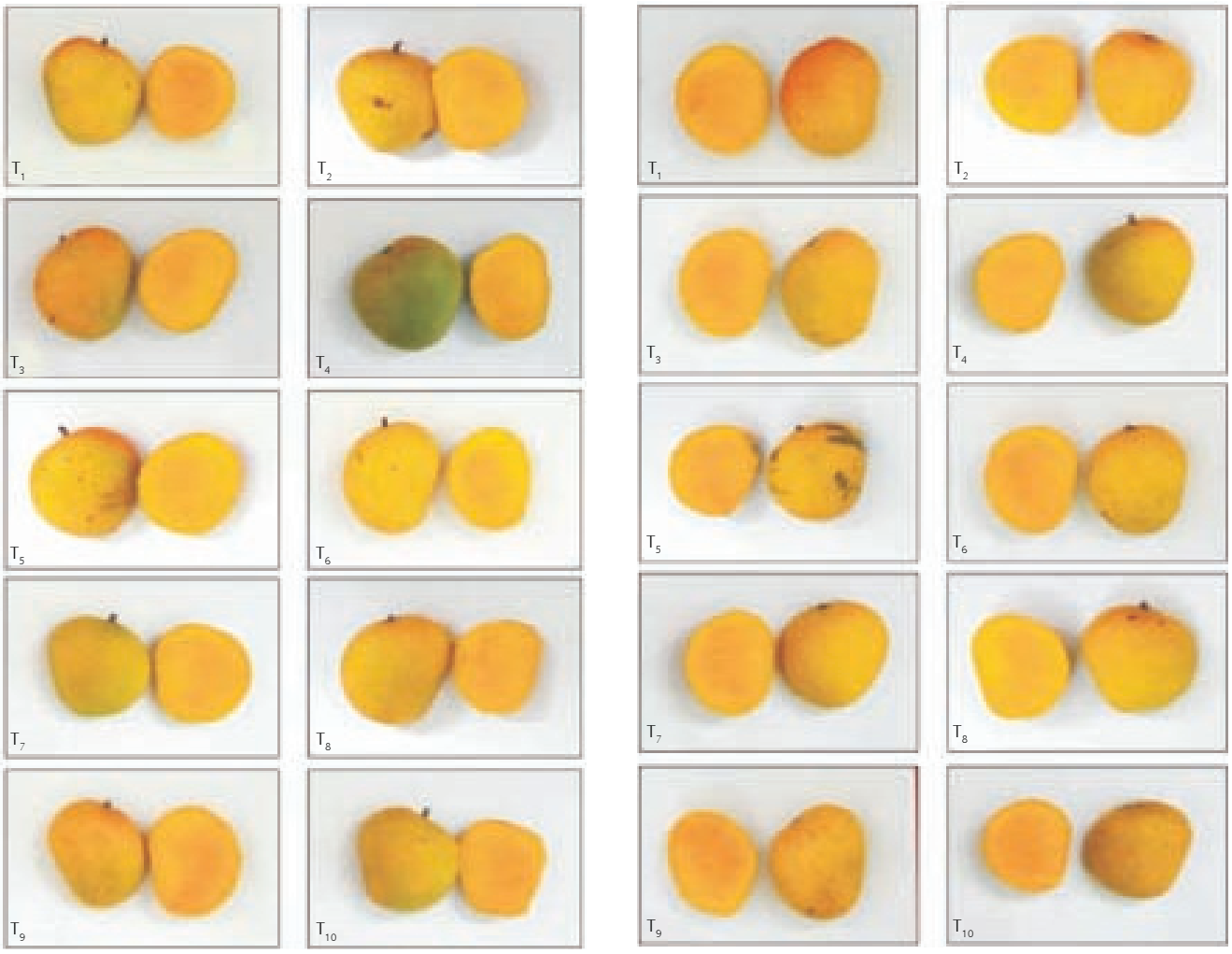

Figure 1: Effect of postharvest treatments on pulp color of mango cv. Alphonso fruits after 4 weeks (13 ± 1°C) and 5 weeks (after 1 week ambient storage).

treatments. However, at the end of ambient storage, treatments, T_9 (74.18) and T_7 (74.13) with higher *h*° angle value were significantly on par with treatments, T_1 (73.92), T_2 (73.72), T_5 (73.74), T_6 (73.60) and T_8 (74.04). The only treatment with significantly lower *h*° angle value was T_4 (70.22) (Table 2).

DISCUSSION

When fruits such as mango ripen, a corresponding increase in chroma value often accompanies an increase in carotenoids (Prono-Widayat *et al.*, 2003). The mean *C** value of mango fruit pulp showed an increasing trend over the storage period with 44.29 at 28 days to 58.29 at 28+7 days. According to Bhaskarachary *et al.* (1995), when mango fruits were transferred to ambient conditions to complete their ripening, significant increase in *C** value was observed and it may possibly be due to additional carotenoid synthesis, since â-carotene in known to predominate over xanthophylls in the latter stages of mango fruit ripening. The treatment T_9 (*Solanum nigrum* leaf extract @ 20% for 5 minutes) showed higher *C** value (55.24), non-significantly followed by the treatments T_1 (54.45), T_8 (54.50), T_{10} (53.56) and T_6 (53.35). The lower *C** value was found in the treatment T_2 (Hot water dip @ 50-55° C for 1 minute) (44.14) and it was on par with the treatment T_4 (Chitosan @ 1% for 1 minute) (46.52). This indicates that hot water treatment retarded the rate of fruit ripening in turn maintaining the colour change with respect to chroma. Heat treatment can alter the senescence of the fruit by reducing the rates of ethylene production, respiration, protein synthesis and softening (Paull, 1990 and Lurie, 1998). Luria *et al.* (2014) observed a decreased expression of chlorophyll and anthocyanin biosynthesis-related genes due to hot water brushing of mango fruits which has the role in the modulation of these processes. When the fruits were transferred to ambient conditions to complete their ripening, there was an increase in the chroma values possibly due to additional carotenoid synthesis. Chitosan treatment showed on par results with hot water treatment which may be attributed to modified atmosphere of the fruit in the chitosan treated fruits resulting in the slow rate of ripening and reduced colour change (Martinez-Romero *et al.*, 2006). The presence of CO_2 around the fruits might be sufficiently high, to suppress the activity of

ethylene, and thus retarding the ripening process. This finding is in accordance with Latifah (1991) in papaya and Chien *et al.* (2007) in citrus.

The hue angle decreased throughout storage and corresponded to an increase in carotenoid synthesis as the fruit gradually ripened indicating change of colour towards redness. Carotenoids will increase in most mango varieties and is associated with the climacteric increase in respiration that is initiated by the action of ethylene (Saltveit, 1999). The maximum h^o value was observed in the treatment T_7 (Azoxistrobin @ 0.1% for 5 minutes) (74.67) which was at parity with the treatments T_1 (73.99), T_2 (73.69), T_5 (73.94), T_6 (74.09), T_8 (73.83) and T_9 (73.85). The minimum h^o was noticed in the treatment T_4 (Chitosan @ 1% for 1 minute) (71.41). The differences in hue and intensity are probably due to the different levels of various pigments synthesized during ripening. Ban *et al.* (2015) observed that the combined treatment of hot water and chitosan was effective in maintaining the physicochemical and other quality changes in wolfberry (*Lycium barbarum*) fruits. The results are in agreement with the findings of Chien *et al.* (2007) who observed delayed synthesis of anthocyanins in papaya, strawberry, litchi, pear and mango fruits coated with chitosan.

REFERENCES

Anju, B., Raj Kumari, K., Monica, R. and Neeraj, G. 2014. Effect of polyamine on shelf life and chilling injury of mango cv. Dashehari. *The Bioscan.* **9(3):** 1097-1100.

Ban, Z., Wei, W., Yang, X., Feng, J., Guan, J. and Li, L. 2015. Combination of heat treatment and chitosan coating to improve postharvest quality of wolfberry (*Lycium barbarum*). *International J. Food Sci. and Tech.* **01**/2015.

Bhaskarachary, K., Sankar Rao, D. S., Deosthale, Y. G. and Reddy, V., 1995, Carotene content of some common and less familiar foods of plant origin. *Food Chem.* **54**: 189-193.

Chien, P. J., Sheu, F. and Lin, H. R., 2007, Coating citrus (Murcott tangor) fruit with low molecular weight chitosan increases postharvest quality and shelf life. *Food Chem.* **100:** 1160-1164.

Jeong, J., Huber, D. J. and Sargent, S. A. 2003. Delay of avocado (*Persea americana*) fruit ripening by 1-methylcyclopropene and wax treatments. *Postharvest Biol. Technol.* **28:** 247–257.

Latifah, M. N. 1991. Effect of modified atmosphere and low temperature of chilling injury and storage life of papaya. *M.Sc. Thesis. Universiti Kembangsaan, Malaysia.*

Lo´pez, C. A. F. and Go´mez, P. A. 2004. Comparison of color indexes for tomato ripening. *Horticultura Brasileira.* **22:** 534-547.

Luria, N., Sela, N., Yaari, M., Feygenberg, O., Kobiler, I., Lers, A. and Prusky, D. 2014. *De-novo* assembly of mango fruit peel transcriptome reveals mechanisms of mango response to hot water treatment. *BMC Genomics.* **15:** 957.

Lurie, S. 1998. Postharvest Heat Treatments. *Postharvest Biol. Technol.* **14:** 257-269.

Martínez-Romero, D., Alburquerque, N., Valverde, J. M., Guillén, F., Castillo, S. and Valero, D. 2006. Postharvest sweet cherry quality and safety maintenance by *Aloe vera* treatment: A new edible coating. *Postharvest Biol. Technol.* **39:** 92-100.

Ninio, R., Lewinsohn, E., Mizrahi, Y. and Sitrit, Y., 2003, Changes in sugars, acids, and volatiles during ripening of koubo (*Cereus peruvianus* L. Miller) fruits. *J. Agril. Food Chem.* **51:** 797-801.

Pandey, S. A. and Dinesh, M. R., 2010, Mango, ICAR, New Delhi.

Paull, R. E., 1990, Postharvest Heat Treatments and fruit ripening. *Postharv. News* Inf. **1(5):** 355-363.

Prono-Widayat, H., Schreiner, M., Huyskens-Keil, S. and Lu¨dders, P. 2003. Effect of ripeness stage and storage temperature on postharvest quality of pepino (*Solanum muricatum* Ait.). *J. Food Agri. Environ.* **1**: 35-41.

Saltveit, M. E. 1999. Effect of ethylene on quality of fresh fruits and vegetables. *Postharvest Biol. Technol.* **15:** 279-292.

Sarkar, K. M., Alam, M. M., Rahman, A. and Bhuiyan, M. G. K., 2011, Post harvest losses in mango value chain. *Intl. J. Biores.* **10(5):** 25-31.

Shalini, K., Sourabh, G. and Komal, K. 2014. Influence of hot water treatment on postharvest quality, antioxidant activity and overall organoleptic characters of ber cv. Gola. *The Ecoscan,* Special issue: **VI:** 493-497.