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# Postharvest Management of Papaya Variety Coorg Honeydew for Distant Market

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***ABSTRACT:*** *Papaya (Carica papaya L.) belongs to family Caricaceae, is one of the economically important fruit crops in many tropical and subtropical countries. India is first among papaya producing countries in the world producing around 5.2 million tons of papaya during 2012-2013. Papaya fruits are highly perishable in nature. Papaya fruit postharvest losses of up to 75% have been reported to Hawaii shippers by mainland USA wholesalers and retailers. The present investigation was under taken at the Department of Processing Technology, College of Agriculture, Vellayani, during 2012-2014, with the objective to standardize postharvest practices for improved shelf life. For distant market fruits are harvested at fully mature green and were sanitized with hot water at 50° C for 20 minutes followed by cooling and warm sodium hypochlorite 150 ppm for 10 minutes. The fruits for were sanitized sanitising agents and waxed and kept in corrugated fibre board boxes with ethylene absorbent potassium permanganate and kept under ambient temperature were studied. Fruits treated with hot water at 50° C for 20 minutes with waxing and with ethylene absorbent recorded highest shelf life of 12.33 days. Potassium permanganate reduces the autocatalytic process of ethylene during ripening and hence delayed the ripening process. In the present experiment all the treatments with waxing resulted in less mechanical damage suggests that waxing might have resulted in reducing the severity of bruises in the skin during the transport.*

***Key words:*** *postharvest management, papaya, coorg honey dew, waxing, $KMnO_4$, shelf life, carotenoids,*

## INTRODUCTION

Papaya (*Carica papaya* L.) is a delicious fruit widely cultivated in tropical and subtropical areas. The cultivated papaya belongs to the family Caricaceae and is the most important economic species in Caricaceae (Paull and Duarte 2011). Papaya with a world production of 12.6 million tons in 2012- 2013 is a major economic crop in tropical countries. India is first among papaya producing countries in the world producing around 5.2 million tons of papaya during 2012-2013 (NHB, 2014).

Papaya fruits are highly perishable and need to be handled with extreme care from the time they are harvested until they reach the consumer. The high content of water, the softness of the fruit on ripening and the vulnerability of the fruit to many postharvest diseases altogether contribute to the substantial increase in postharvest losses. The postharvest losses of papaya fruit is one of the highest among various horticultural crops. The estimated postharvest losses of papaya fruits had been up to 75% have been reported to Hawaii shippers by mainland USA wholesalers and retailers. These losses are associated with mechanical injury, fruit ripening, chilling injury and postharvest diseases (Paull and Chen, 2014).

Harvesting of fruits at proper stage of maturity is of paramount importance for attaining desirable quality. The level of maturity actually helps in selection of storage methods, estimation of shelf life and selection of processing operations for value addition. Maturation is the developmental process by which the fruit attains maturity. It is the transient phase of development from near completion of physical growth to attainment of physiological maturity (Dhatt and Mahajan, 2007).

Various destructive and non-destructive indices can be used to determine the harvest maturity of papaya. The non-destructive index includes the

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number of days from flowering, fruit size, and external colour. It is important to harvest papaya fruit at the proper maturity stage, because they do not increase in sugar content after picking. Hawaiian papayas normally require about 3 months from flowering until fruit maturity. The most obvious index of fruit maturity is external skin colour. As the fruit matures, the skin colour will change from green to yellow or orange (New GMC, 2004).

New Guyana Marketing Co-operation published the postharvest care and market preparation for papaya. According to them domesticated market fruits should be harvested when the skin colour is between one quarter to one half yellow while for export it should be harvested between the one stripe yellow stage and the quarter ripe stage (New GMC, 2003).

The use of heat treatments in postharvest management is applied to many kinds of fruits to prevent fungal and insect eradication (Paull, 1994; Lurie, 1998). Heat treatments (hot water, hot air, vapour heat) may be used for disease control (such as anthracnose on mango and crown rot on banana) and for insect control to meet quarantine requirements for some commodities, such as mango and papaya (Kader, 2013).

Martins *et al.* (2010) reported that treatment of papaya fruit with hot water at 48-50° C for 20 minutes controlled the *Colletrotrichum gleosporioides* and *Phoma caricae*.

Kechinski *et al*. (2012) applied heat treatments with a hot water brushing system at temperatures of 45, 55 and 65° C in papaya fruits. No mould was observed under the wax film of fruits treated with hot water, ozonated water and wax, indicating that the combined treatment effectively disinfected the papaya fruits.

Many studies have been conducted in order to understand the post-harvest factors that influence papaya quality. The high content of water, the softness of the fruit on ripening and the vulnerability of the fruit to many postharvest diseases altogether contribute to the substantial increase in postharvest losses. Thus an integrated approach controlling postharvest disease, mechanical damage and fruit ripening should be considered to extend the shelf life.

## MATERIALS AND METHODS

The present investigation was under taken at the Department of Processing Technology, College of Agriculture, Vellayani, Kerala Agricultural University, Thrissur, during 2012-2014, with the objective to standardize postharvest practices for improved shelf life.

For distant market fruits were harvested at fully mature green stage and were sanitized with hot water at 50° C for 20 minutes followed by cooling and warm sodium hypochlorite 150 ppm for 10 minutes. The fruits for were sanitized sanitising agents and waxed and kept in corrugated fibre board boxes with ethylene absorbent and kept under ambient temperature were studied. The wax used was carnauba wax applied by hand with a sponge, and the papaya fruits were air-dried under the fan as previously described by Kechinski *et al.,* (2012).

The ethylene absorbent used was $KMnO_4$ pallets taken in muslin cloth sachet of 1.5 $cm^2$ at the rate of 8.0 g/ kg of fruit. These sachet were kept in corrugated fibre board packages containing papaya fruits.

Treatments

The fruits selected as the fully mature green stage of harvest for distant market was subjected to the following treatments.

$T_1$ - $W_a$ + $X_1$ + $E_1$ ( hot water @ 50° C for 20 minutes + waxing+ ethylene absorbent)

$T_2$ - $W_a$ + $X_1$ + $E_2$ (hot water @ 50° C for 20 minutes + waxing +without ethylene absorbent)

$T_3$ - $W_a$ + $X_2$ + $E_1$ (hot water @ 50° C for 20 minutes +without waxing+ ethylene absorbent)

$T_4$ - $W_a$ + $X_2$ + $E_1$ (hot water @ 50° C for 20 minutes +without waxing+ without ethylene absorbent)

$T_5$ -$W_b$ + $X_1$ + $E_1$ (warm sodium hypochlorite 150 ppm for 10 minutes + waxing+ ethylene absorbent)

$T_6$ -$W_b$ + $X_1$ + $E_2$ (warm sodium hypochlorite 150 ppm for 10 minutes + waxing+ without ethylene absorbent)

$T_7$ -$W_b$ + $X_2$ + $E_1$ (warm sodium hypochlorite 150 ppm for 10 minutes + without waxing+ ethylene absorbent)

$T_8$ -$W_b$ + $X_2$ + $E_2$ (warm sodium hypochlorite 150 ppm for 10 minutes + without waxing+ without ethylene absorbent)

$T_9$ – Control

## OBSERVATIONS

### Shelf Life

In each treatment, fruit at fully ripe stage was considered as the end of the shelf life in that particular treatment and expressed in days.

### Percent Leakage

The uniform sized fruit pieces were made into thin slices, immersed in 20 ml distilled water for three

hours and absorbance was read in UV spectrophotometer at 273 nm. The immersed slices were heated in water bath at 100° C for 20 minutes, filtered, filtrate was made upto 20 ml and the absorbance was read in UV spectrophotometer at 273 nm. The loss of membrane integrity was expressed in per cent ion leakage. Percent leakage was calculated using the formula and expressed as percentage (Amith, 2012):

$$Percent\ leakage = \frac{Initial\ absorbance\ of\ bathing\ medium}{Final\ absorbance\ of\ bathing\ medium} \times Dilution\ factor$$

**Mechanical Damage**

Skin injury was expressed as percent of fruit surface area affected. Severity of injury was estimated subjectively on a scale from zero to three (Quintana and Paull, 1993).

0 - None
1 - Light green impact area
2 - Medium green
3 - Dark green

**Quality Parameters**

***Carotenoid***

Carotenoids were estimated as per the procedure of Saini *et al*., (2001) and expressed as mg/ 100g of treated fruit.

***Total Soluble Solids***

Total Soluble Solids (TSS) was recorded directly using Erma Hand refractometer (range 0 -32° brix) and expressed in degree Brix (°B).

***Acidity***

The titratable acidity was estimated as per the procedure described by Ranganna (1991) and expressed as per cent anhydrous citric acid.

***pH***

The pH was recorded using electronic pH meter (Saini *et al*., 2001).

***Statistical Analysis***

The observations were analyzed statistically in a Completely Randomized Design (CRD) and significance was tested using analysis of variance technique (Gomez and Gomez, 1984).

**RESULTS**

**Shelf Life**

The shelf life of the papaya fruits showed significant variation among treatments. The effect of pre storage treatments on shelf life of papaya var. Coorg Honeydew for distant market is shown in Fig. 1. The fruits treated with hot water treatment at 50° C for 20 minutes with waxing and with ethylene absorbent showed highest shelf life, $T_1$ (12.33 days). The control sample, $T_9$ had lowest shelf life (5.33 days). This might be because of the delay in ripening process due to modified atmospheric condition brought about by waxing and ethylene absorbents and the less decay due to less microbial load in these treatments.

Potassium permanganate oxidises the ethylene produced by the fruit during ripening extends the pre-climacteric period and the postharvest life (Resende *et al*. 2001).The reduction in ethylene effected by addition of potassium permanganate subsequently forced to delay the ripening of many climacteric fruits was also reported by Wills and Warton (2004).

Dikki *et al*. (2010) reported that postharvest treatment with 6.0 per cent wax coating and 250 ppm NAA resulted in extending the shelf life of papaya up to 15 days at room temperature as against the 7 days of shelf life of untreated fruits. Geetha and Thirumaran (2010) also observed one week and four week increase in shelf life in waxed vacuumed papaya fruits kept under room temperature and refrigeration process.

The effect of $KMnO_4$ on the extension of postharvest life of 'Sunrise Golden' papaya stored under modified atmosphere and refrigeration was reported by Silva *et al*. (2009). The effectiveness of MgO and $KMnO_4$ in modified atmosphere package extended the postharvest life of papaya cv. Rathna (Jayathunge *et al*., 2011).

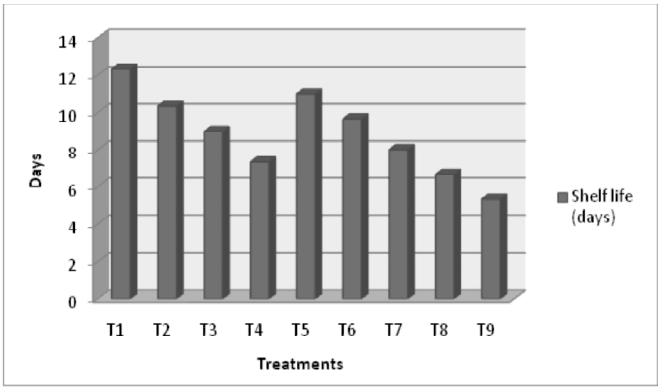


**Figure 1: Effect of prestorage treatments on shelf life of papaya var. Coorg Honeydew for distant market**

**Table 1**
**Effect of prestorage treatments on percent leakage, mechanical damage, carotenoids, TSS and acidity of papaya var. Coorg Honeydew for distant market**

| *Treatments* | *Percent leakage* | *Mechanical damage* | *Carotenoids (mg/100g)* | *TSS (°Brix)* | *Acidity (%)* | *pH* |
|---|---|---|---|---|---|---|
| $T_1$ | 57.82 | 0.33 | 1.80 | 11.33 | 0.13 | 5.43 |
| $T_2$ | 72.55 | 0.33 | 1.67 | 10.66 | 0.15 | 5.46 |
| $T_3$ | 76.32 | 1.33 | 1.53 | 10.66 | 0.15 | 5.63 |
| $T_4$ | 90.87 | 1.33 | 1.59 | 10.33 | 0.15 | 5.90 |
| $T_5$ | 69.18 | 0.33 | 1.70 | 11.66 | 0.18 | 5.56 |
| $T_6$ | 75.17 | 0.33 | 1.74 | 10.66 | 0.15 | 5.60 |
| $T_7$ | 74.28 | 1.33 | 1.67 | 11.00 | 0.20 | 5.70 |
| $T_8$ | 93.69 | 1.33 | 1.65 | 10.33 | 0.13 | 5.63 |
| $T_9$ | 97.48 | 1.67 | 1.63 | 10.00 | 0.11 | 5.76 |
| SE | 2.04 | 0.333 | 0.139 | 0.293 | 0.040 | 0.115 |
| CD (0.05) | 6.079 | 0.9904 | NS | 0.8734 | NS | NS |

**Percent Leakage**

The fruits treated with hot water treatment at 50° C for 20 minutes with waxing and with ethylene absorbent ($T_1$) had least percent leakage (57.82 per cent) and untreated sample ($T_9$) recorded highest percent leakage (97.48 per cent). According to Parker and Maalekuu, (2013) high water loss rate showed very high and positive correlation with membrane ion leakage. The higher percent ion leakage in control might be due to the loss of physical integrity of cellular membrane leading to the loss of ion leakage.

**Carotenoids**

No significant difference was found between the treatments.

**Total Soluble Solids (TSS)**

Total soluble solids recorded a significant difference between treatments. The highest total soluble solids was recorded in fruits treated with the warm sodium hypochlorite, 150 ppm for 10 minutes with waxing and with ethylene absorbent, $T_5$ (11.66° B), which was on par with the hot water treatment at 50° C for 20 minutes with waxing and with ethylene absorbent, $T_1$ (11.33° B), warm sodium hypochlorite, 150 ppm for 10 minutes without waxing and with ethylene absorbent, $T_7$ (11.00° B). The lowest TSS was found in control sample, $T_9$ (10.00° B). TSS was found to be significantly highest in the waxed fruit; the result was in close confirmation with the finding of Dikki *et al*., (2010).

**Acidity**

There is no significant difference between the treatments for acidity. It has been reported that ethylene absorbent treatment had no significant effects on titratable acidity (Osman *et al*., 2013).

**pH**

No significant difference was observed in pH for all the treatments. The pH of the fruit juice showed that it was weakly acidic. The pH value did not change throughout the ripening process.

The Eksotika papaya fruits harvested at different harvest maturity, treated with hot water at 47±1°C for 10 minutes and another group was untreated. The pH value did not change throughout the ripening process. A value of about 5.6–5.7 was obtained in treated and untreated fruit (Arina *et al*., 2010).

**Mechanical Damage**

The mechanical damage during harvest was practically nil. However during transport the mechanical damage recorded showed significant difference between treatments shown in Table 1. For the fruits treated with hot water treatment at 50° C for 20 minutes with waxing and with ethylene absorbent ($T_1$), hot water treatment at 50° C for 20 minutes with waxing and without ethylene absorbent ($T_2$), warm sodium hypochlorite 150 ppm for 10 minutes with waxing and with ethylene absorbent ($T_5$) and warm sodium hypochlorite 150 ppm for 10 minutes with waxing and without ethylene absorbent ($T_6$) lowest score was noted in mechanical damage (0.33). The control sample ($T_9$) recorded highest score for mechanical damage (1.67) due to bruises. Mechanical damage during harvesting, packaging and transport can result in a substantial reduction in quality. Ideally, such damage would be minimized through improved understanding of the mechanisms (Li and Thomas 2014).

According to Quintana and Paull (1993) waxing reduced the severity of skin injury. New GMC (2004) reported that application of a surface wax on papaya

fruit generally with carnauba or shellac based wax reduced shrinkage and gave the fruits a glossy appearance.

## CONCLUSION

Papaya var. Coorg Honeydew fruits harvested at fully mature green were treated with hot water 50° C for 20 minutes with waxing and with ethylene absorbent recorded highest shelf life of 12.33 days, by using ethylene absorbent, whatever ethylene that was produced might have been oxidised by $KMnO_4$ thus reducing the autocatalytic process of ethylene during ripening and hence delayed the ripening process. In the present experiment all the treatments with waxing resulted in less mechanical damage suggests that waxing might have resulted in reducing the severity of bruises in the skin during the transport.

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