INFLUENCE OF HOT WATER TREATMENT ON STORAGE AND FRUIT QUALITY OF PEACH FRUIT

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ABSTRACT

The influence of hot water treatment on quality attributes of peach at various storage intervals was assessed at Horticultural laboratory, Department of Horticulture, The University of Agriculture Peshawar during 2013. Fruits of Peach cv. 'Early Grand' were dipped in hot water at different temperatures (Control, 30, 40 and 50 °C) for a constant time period of 5 minutes. After drying, the fruits were stored at (5-8 ^{0}C) and then their chemical analysis and other quality parameters were studied at the end of each storage interval (0, 10, 20 and 30 days). The results indicated that there was a significant influence of the given treatments on quality of peach fruit. The fruits dipped in water having temperature of 50 °C showed the maximum juice pH (3.54), weight loss (7.63%), with minimum juice content (63.66%), ascorbic acid (4.30 mg.100g^{-1}). The fruits dipped in water at 40°C showed minimum weight loss (2.57%) and disease incidence (14.17%). The alone effect of storage periods revealed that the fruits stored for 30 days gave the maximum juice content (67.87%), weight loss (10.41%), disease incidence (47.50%) and juice pH (3.91) but also showed the minimum fruit firmness (0.41 kg.cm^{-2}). The interaction between hot water levels and storage durations proved that the peach fruits dipped in water having temperature of 40 °C and stored for 20 days showed the maximum weight loss (16.90%) and disease incidence (80%). While increasing the hot water temperature (from 40 to 50 °C) and storage duration (from 20 to 30 days), most of the peach fruit quality attributes were declined with passage of time. From the results it was concluded that the hot water treatment at certain temperature i.e. 40 °C effectively sustained the quality traits of peach fruit (juice content, juice pH) and minimized the percent disease incidence and fruit pH. Therefore it was recommended that peach fruits may be treated with water having temperature of 40 °C after harvest to sustain quality aspects for 10-20 days storage at 5-8 °C.

Keywords: Peach fruit, Hot water treatment, Storage durations

INTRODUCTION

Peach (*Prunus persica*) belongs to the family Rosaceae, it is the widely grown fruit in temperate regions throughout the world. Around 2000 B.C, peach was originated in China as in a wild form. At the time of Holy Christ, Romans were cultivating peach and later on it was disseminated in all over the world after The Romans spread it in their entire empire of Europe (Ferguson *et al*., 1987). In Pakistan, it is grown in Khyber Pakhtunkhwa Province and has got its importance. It is also grown in other areas of Pakistan like South Waziristan, Gilgit, Chitral and Hunza valley. According to Pakistan Agricultural Statistics in 2010-2011, a total of 52600 tons of peach fruit were produced under the area of 15200 hectares. Peach cover on an area of

100 hectares in Punjab, 5600 in Khyber Pakhtunkhwa and 9500 hectares in Baluchistan with production of 500, 57800 and 25400 tons respectively. Due to various biotic and abiotic stresses like disease attack, insects and most importantly lack of proper preservation, the yield of peach in Khyber Pakhtunkhwa province is very low (Khattak, 2002). The fresh products play an important role in the market competition and its value is more in local and international market. Due to the nature of their perishability, diversity of horticulture, convenience and customer preferences, the conservation of product quality demands constant attention (Louis *et al*., 2001).

Shelf life of a fruit can be increased by giving proper post-harvest treatments. It also reduces packaging house losses. There are a very limited number of registered products in post-harvest regulations. Heat treatment given before storage is a very relevant strategy which provides fruits with less damage and better quality (Lurie, 1998). A high temperature application to the fruits is an example of physical treatments given in post-harvest in order to delay fruit ripening, control pest, reduce disease incidence, improve the fruits resistance against chilling injuries, and extent the shelf life (Wang, 2010). There are certain changes caused by the heat treatments, i.e. changes in ripening of fruits and inhibition in synthesis. Cell wall degrading enzymes are also triggered due to protein synthesis and alteration in gene expression (Paull and Chen, 2000).

Heat treatment of the fruits for quality maintenance has been given in a wide range of international scientists work. Increase in protein levels and transcripts of heat shock proteins are caused due to this treatment (Lurie, 1998). Many other processes in fruit ripening are influenced by heat treatments, i.e. color, cell wall metabolism, respiration, ethylene production, fruit softening and volatile compounds production (Tian *et al*., 1996; Ketsa *et al*., 1999; Lurie and Nussinovich, 1996; McDonald *et al.*, 1999). Heat application followed by cold storage can decrease chilling injuries, pathogen incidence and development in many fruits (McDonald *et al.*, 1999). It has been stated by Margosan *et al*. (1997) that peach fruits exposed to hot water of 46 ^{0}C up to 8 min showed significantly less disease incidence.

MATERIALS AND METHODS

Two different factors were studied, i.e. hot water treatments and storage durations. The hot water treatments were given for a constant time period of 5 minutes. The distilled water was used in the whole experiment. After thoroughly washing, four lots of fruits were made before the process of treatment. The fruits were treated with hot water for five minutes at different temperatures (30 ^{0}C, 40 ^{0}C and 50 ^{0}C). Some fruits were left without dipping as "control". After the treatment and cooling of the selected fruits they were kept for storage for different time of interval such as 0 day, 10 days, 20 days and 30 days respectively.

Proposed Plan of study for research

T_o	=	Peach fruit untreated.
T_1	=	Peach fruit treated with hot water at 30 ^{0}C for 5 minute.
T_2	=	Peach fruit treated with hot water at 40 ^{0}C for 5 minute.
T_3	=	Peach fruit treated with hot water at 50 ^{0}C for 5 minute.

Statistical Procedure

To Analysis of Variance (ANOVA) all the data will be added and used the procedure suitable for RCBD with two factors arrangement. Least Significance Differences (LSD) test for these analyses used to compare the means. Statistix 8.1 is used as statistical package (Jan *et al*., 2009).

RESULTS AND DISCUSSION

Fruit Juice content (%)

The mean table showed that the more juice content (70.78%) was noted in control fruits, followed by (69.62 and 68.07%) noted in the fruits treated with water having 50 ^{0}C and 40 ^{0}C temperature respectively. While the less juice content (67.64%) was noted in the fruits treated with water having temperature of 30 ^{0}C (Table 1).

As regarding the storage durations, the maximum juice content (72.74%) was noted in fruits stored for 30 days, followed by the values (70.04 and 68.16 %) observed in the fruits stored for 20 and 10 days respectively, whereas the low juice content value (65.17%) was observed in fresh fruits. As referred to the mean values of interaction, the highest fruit juice content value (75.11%) was observed in the fruits dipped in water having 40 ^{0}C and stored for 30 days, while the minimum was recorded in fruits dipped in water having temperature of 30 ^{0}C of fresh peach fruit.

These results are in harmony with khan *et al.* (2007), their finding suggested that the juice content in sweet oranges increased with increasing storage duration up to 45 days but in some treatments juice contents decreased after 60 days interval of storage. According to Murray *et al.* (2007), the juiciness of fruit was improved due to combined heat and storage treatments even after 4 weeks of storage. The fruits which were treated with hot water had a redder skin color than the fruits receiving other treatments.

Fruit Weight Loss (%)

The mean table revealed that the highest value of weight loss (7.63%) was observed in the fruits dipped in water having temperature of 50 ^{0}C, followed by the value (5.04%) of the fruits lefts untreated, while the minimum weight loss (2.57%) was observed in fruits dipped in water having temperature of 40 ^{0}C, which was at par statistically with the value (2.94%) observed in the fruits dipped in water having temperature of 30 ^{0}C (Table 1)

As regarding to the different time of storage, the maximum weight loss (10.41%) was noted in fruits put in storage for 30 days, trailed by the values (4.63 and 2.36%) found in fruits kept for 20 days and 10 days, while the minimum weight loss (0.76%) was observed in fresh fruits. As referred to the mean values of interaction, maximum weight loss (16.90%) was observed in the fruits dipped in water having temperature of 50 ^{0}C and stored for 30 days, while the minimum was recorded in control and fresh fruit.

The parallel effects were also observed by (Casals *et al.,* 2010), who stated that peach fruits treated at 40-45 ^{0}C gave lower weight loss. Similarly, (Tareen *et al.,* 2012) detected that during time of storage an increase in weight loss occurred with increasing tendency in all the treatments. Ozdemir *et al.* (2010) also observed increase in fruit weight loss in grapes during storage intervals. Khan *et al.* (2007) also observed increase in the weight loss of the fruit with the increase of heat treatment duration.

Ascorbic acid content (mg 100g^{-1})

According to the mean table, the maximum ascorbic acid content (6.03 mg 100g^{-1}) was noted down in the control fruits, followed by the contents (5.50 and 5.07 mg 100g^{-1}) recorded in the fruits dipped in water having temperature of 30 ^{0}C and 40 ^{0}C water respectively, while the minimum (4.30 mg 100g^{-1}) was observed in fruits dipped in water having temperature of 50 ^{0}C (Table 1).

As referred to storage intervals, the maximum ascorbic acid content (5.45 mg 100g^{-1}) was recorded in fresh fruits, which was statistically the same as the value (5.34 mg 100g^{-1}) found in fruits stored for 10 days, which was at par with the contents (5.10 mg 100g^{-1}) of fruits kept for 20 days and the contents (5.02 mg 100g^{-1}) recorded in fruits stored for 30 days which was the minimum value.

These results are in line with the results of Rapisarda *et al.* (2001) who observed a decrease in ascorbic acid contents during storage of different fruits. Similarly, Kinh *et al*. (2001)

observed that ascorbic acid contents of apple decreased during storage. Yahia *et al.* (2007), also reported that level of ascorbic acid content was higher in control fruits as compared to the fruits of tomato which were treated with hot water. Fruits are natural sources of ascorbic acids (vitamin C) and it is known that the ascorbic acid of fruits decreases during ripening and processing.

Table 1: Fruit Juice content (%), Weight loss (%) and Ascorbic acid content (mg 100g^{-1}) of peach fruit as affected by hot water treatment during storage.

	Parameters		
Hot water treatment	**Fruit Juice content (%)**	**Weight loss (%)**	**Ascorbic acid content (mg 100g^{-1})**
Control	70.78 a	5.04 b	6.03 a
30 ^{0}C	67.64 b	2.94 c	5.50 b
40 ^{0}C	68.07 ab	2.57 c	5.07 c
50 ^{0}C	69.62 ab	7.63 a	4.30 d
LSD (P≤0.05)	2.90	1.24	0.34
Storage durations (days)			
Fresh (0)	65.17 c	0.76 d	5.45 a
10	68.16 b	2.36 c	5.34 ab
20	70.04 ab	4.63 b	5.10 b
30	72.74 a	10.41 a	5.02 b
LSD (P≤0.05)	5.81	2.49	1.24
Interaction at LSD (P≤0.05)			
Hot water × Storage	---	---	---
Significance	NS	NS	NS

Means followed by same letters are statistically different using LSD test at 5% Significance levels.

Disease Incidence (%)

According to the mean table, the maximum disease incidence (49.17%) was observed in the fruits dipped in water having temperature of 50 ^{0}C, followed by the contents (25.00 and 20.00 %) recorded in control fruits and the fruits dipped in water having temperature of 30 ^{0}C water respectively, while the minimum (14.17%) was noted in fruits dipped in water having temperature of 40 ^{0}C (Table 2).

As regarding the different storage duration, the maximum disease incidence (47.50%) was recorded in fruits stored for 30 days, followed by the values (35.84 and 25.00%) found in fruits put in storage for 20 days and 10 days, whereas the low value of disease incidence (0.00%) was observed in fruits not stored. As referred to the mean values of interaction, the maximum disease incidence (80.00%) was observed in the fruits dipped in water having temperature of 50 $^{\circ}$C water and stored for 30 days, while the minimum was recorded in control and fresh fruits.

These results are in correspondence with Liu *et al.* (2012) in peach fruits, that, when peach fruits treated with 40 ^{0}C gave better result as compared to other treatments. Ghasemnezhad *et al.* (2008) resulted that temperature above than 47.5 ^{0}C for 2 and 5 min, respectively, showed that fruits were susceptible to heat damage resulted in rind browning. Basal level of skin damage was observed in all heat treatments. The hot water treatments also cleaned the fruit surface, melted the waxes, and sealed the open stomata. (Yuan *et al.*, 2013). According to Fallik *et al.* (2004), to avoid the fruit damage, duration of the fruits should be used accordingly, i.e. fruits treated with high temperature should kept for short duration and fruits treated with low temperature should kept for long duration.

Fruit juice pH

The mean table revealed that the maximum fruit juice pH (3.69) was observed in the fruits dipped in water having temperature of 50 ^{0}C, followed by the value (3.60 and 3.57) of the fruits dipped in water having temperature of 40 ^{0}C and 30 ^{0}C respectively, while the minimum fruit juice pH (3.54) was observed in control fruits (Table 2).

As referred to storage intervals, the maximum fruit juice pH (3.91) was noted in fruits put in storage for 30 days, trailed by pH (3.68 and 3.51) found in fruits stored for 20 days and 10 days respectively, the pH (3.30) recorded in fresh fruits.

Similar results were also observed by Robertson *et al.* (1990) who observed increased in fruit juice pH with increasing storage intervals as compared to control fruits. In general a decrease in juice acidity of fruits and an increase in pH was found along with duration of storage. Due to increasing in duration of storage the pH of tomato fruit was also increased at room temperature (Mohammed *et al.*, 1999).

Table 2: Disease Incidence (%) and Fruit juice pH of peach fruit as affected by hot water treatment during storage.

	Parameters	
Hot water treatment	**Disease Incidence (%)**	**Fruit juice pH**
Control	25.00 b	3.54 b
30 ^{0}C	20.00 bc	3.57 b
40 ^{0}C	14.17 c	3.60 ab
50 ^{0}C	49.17 a	3.69 a
LSD (P≤0.05)	6.68	0.09
Storage durations (days)		
Fresh (0)	0.00 d	3.30 d
10	25.00 c	3.51 c
20	35.84 b	3.68 b
30	47.50 a	3.91 a
LSD (P≤0.05)	13.36	0.18
Interaction at LSD (P≤0.05)		
Hot water × Storage	---	---
Significance	NS	NS

Means followed by same letters are statistically different using LSD test at 5% Significance levels.

Conclusion

Hot water treatment significantly affected all qualitative parameters. Among the hot water treatments hot water at 40^{o}C showed best results to minimize the disease incidence, enhanced the fruit juice pH of peach fruit. Storage duration up to 10 days was found to be the most effective for weight loss, ascorbic acid content, disease incidence and a gradual decline was also noted with increasing the storage duration.

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