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RESEARCH PAPER

Effect of polyamines on quality attributes of stored peach fruits

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Abstract : Peach is a perishable fruit and it is difficult to maintain the fruit quality at ambient conditions for a longer time. A study was conducted to enhance the storage life of peach fruits under cold storage conditions. For storage study, peach fruits of cv. Shan-i- Punjab were harvested at physiological mature stage and subjected to post-harvest dip treatments of polyamines *viz*; spermidine, spermine and putrescine before storage and kept at 0-1^{0}C and 90-95% relative humidity for a period of 32 days. During storage fruits were evaluated for quality parameters after 8, 16, 24 and 32 days of storage. During investigation period fruit quality parameters changed with advancement of storage period. Results revealed that post-harvest treatments of spermidine, spermine and putrescine were effective in maintaining the peach fruit quality and extending post-harvest life under cold storage conditions. Putrescine @ 3 mmol L^{-1} treatments was found effective in maintaining firmness, pulp: stone ratio, total soluble solids, acidity, reducing sugars and non-reducing sugars during the entire storage period.

Key Words : Peach, Storage, TSS, Quality, Spermidine, Spermine, Putrescine

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INTRODUCTION

Peach [*Prunus persica* (L.) Batsch] is one of the major stone fruit grown in the temperate zones of the world. In sub-tropical climate, peach cultivation did not make much headway earlier, mainly because of non-availability of early ripening and superior quality varieties. But, with the introduction of low chilling cultivars from United States, the peach cultivation has greatly expanded in the North Indian plains especially in Punjab. Presently, varieties like Shan-i-Punjab, Partap and Earli-Grande are grown commercially in the state and Shan-i- Punjab occupied the maximum part of the area covered by peach. Under Punjab conditions ripening period of peach fruit coincides with the hot summer month (May) and fruits cannot be kept for longer period at ambient conditions. To overcome this problem, attempts have been made to keep the surplus fruits in cold stores to extend post-harvest life and marketability of fruits. But, fruit quality parameters like fruit firmness, pulp: stone ratio, total soluble solids, acidity, reducing sugars and non-reducing sugars are highly affected during storage. Many chemicals *viz*., fungicides, growth regulators and nutrients have been reported to delay ripening and extend the post-harvest life of fruits. Kumar *et al.* (1997) stated that polyamines are described as anti-senescent agents and their level usually decreases during the ripening period in most of the fruits. This general diminution affects textural attributes and shelf life. The bonds between polyamines and pectin inhibit the activity of wall-degrading enzymes, such as pectinesterase, pectinmethyl-esterase and polygalacturonase and reduce fruit softening during storage (Valero *et al.*, 2002). Walling (2001) reported the effect of polyamines on fruit quality and storage life of 'Ponkan' mandarin fruits. Higher fruit firmness in putrescine treated fruits may be due to the role of polyamines in stabilizing cell walls, or by making cell walls less accessible to wall-softening enzymes (Kramer *et al.*, 1991). Keeping the above facts in view, present investigation was

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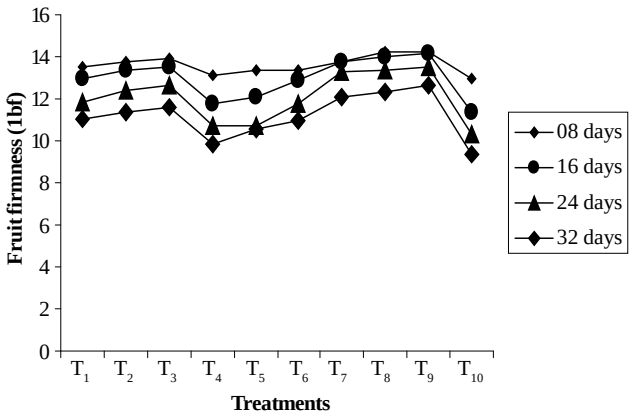
undertaken to extend the post-harvest life and reduce the post-harvest losses in peach cv. Shan-i-Punjab.

MATERIAL AND METHODS

The present investigation was carried out in the Department of Fruit Science, Punjab Agricultural University, Ludhiana during the year 2012. The fruits of peach cv. Shan-i-Punjab were harvested, from the PAU Seed Farm, Ladhowal and the experiment was conducted in the post-harvest laboratory, Department of Fruit Science, Punjab Agricultural University, Ludhiana. Physiologically mature, uniform and healthy fruits of cv. Shan-i-Punjab were harvested and treated for 5-minutes in aqueous solutions of spermidine, spermine and putrescine at three different concentrations *viz.*, 1.0, 2.0 and 3.0 mmol L^{-1}, respectively. Ten treatments were given comprising three replications in each treatment; T_1 [Spermidine (1.0 mmol L^{-1})], T_2 [Spermidine (2.0 mmol L^{-1})], T_3 [Spermidine (3.0 mmol L^{-1})], T_4 [Spermine (1.0 mmol L^{-1})], T_5 [Spermine (2.0 mmol L^{-1})], T_6 [Spermine (3.0 mmol L^{-1})], T_7 [(Putrescine 1.0 mmol L^{-1})], T_8 [Putrescine (2.0 mmol L^{-1})], T_9 [Putrescine (3.0 mmol L^{-1})] and T_{10} [Control (Water dip)]. Treated fruits were air dried under shade before packaging. For storage studies 2.0 kg fruits from each replication of each treatment were packed in corrugated fiber board (CFB) boxes (5% perforation) with paper lining and kept at low temperature conditions (0 -1° C and 90-95% RH) for 32-days. Fruit samples were analysed after 8, 16, 24 and 32 days of storage for various physico-chemical characterstatics. Firmness of randomly selected fruits (three from each replication) was measured with the help of fruit pressure tester (Model FT- 327, USA) and expressed in terms of lbf. Pulp: stone ratio was calculated by dividing the values of weight of pulp to the corresponding weight of stone. Total soluble solids (TSS) were determined from the juice at room temperature with the help of hand refractometer (Model Erma, Japan) and expressed in per cent. The readings were corrected with the help of temperature correction chart at 20°C temperature (AOAC, 1990). Acidity was determined by titrating 2 ml of stained juice of fruits against 0.1 N NaOH solution using phenolphthalein as an indicator. The appearance of light pink colour marked the end point of titration. The percentage of titratable acidity was calculated and expressed in terms of anhydrous maleic acid. Reducing sugars were estimated by AOAC (1990) methods. The non-reducing sugars were calculated by subtracting reducing sugars from total sugars and multiplied by 0.93. The data were statistically analyzed by Factorial Completely Randomized Block Design (CRD) as described by Singh *et al.* (1998).

RESULTS AND DISCUSSION

Data presented in Fig.1, revealed that the fruit firmness

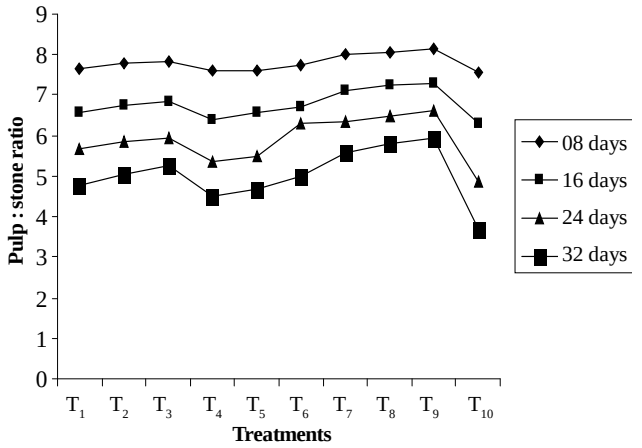


C.D. (P-0.05)
Temperature : 0.17 Storage 0.11 Storage x treatment : 0.33

Fig. 1 : Effect of post-harvest treatments of polyamines on firmness of stored peach fruits

decreased as the storage interval increased. After 8 days of cold storage, the maximum fruit firmness (14.25 lbf) was found in putrescine @ 3 mmol L^{-1} treated fruits and the minimum fruit firmness (12.97 lbf) was in control fruits. Similar trend was followed at 2nd, 3rd and 4th interval *i.e.* after 16, 24 and 32 days of storage. During the entire storage period, the putrescine @ 3 mmol L^{-1} treated fruits retained the maximum (14.25-12.62 lbf) fruit firmness and the minimum fruit firmness (12.97-9.39 lbf) was recorded in untreated fruits followed by spermine (1 mmol L^{-1} and 2 mmol L^{-1}). Softening of fruits is caused either by the breakdown of insoluble protopectins into soluble pectins or by the cellular disintegration leading increased membrane permeability (Mattoo *et al.*, 1975). Higher fruit firmness in putrescine treated fruits may be due to the role of polyamines in stabilizing cell walls, or by making cell walls less accessible to wall-softening enzymes (Kramer *et al.*, 1991). Blueberry fruits dipped in putrescine solution maintained the higher firmness as compared to control (Basiouny 1996). Khan *et al.* (2007) also reported that the application of putrescine retarded the plum fruit softening during low temperature storage. Similarly, Romero *et al.* (2001) recorded an increase in fruit firmness with putrescine treatments in apricot fruits as compared to untreated fruits.

Fruit pulp: stone ratio decreased with the progression of storage period (Fig. 2). Putrescine @ 3 mmol L^{-1} treated fruits recorded maximum pulp: stone ratio which ranged between 8.13-5.92 and the minimum pulp: stone ratio was ranged between 7.57-3.70 in case of reference fruits during the entire storage period. The decrease in pulp: stone ratio with the advancement of storage period may be due to the increase in moisture loss from the peach fruits. Akhtar *et al* (2010) also reported the decrease in pulp: stone ratio with advancement of storage period in loquat. Pre-harvest application of putrescine @ 3 mmol L^{-1} maintained the higher



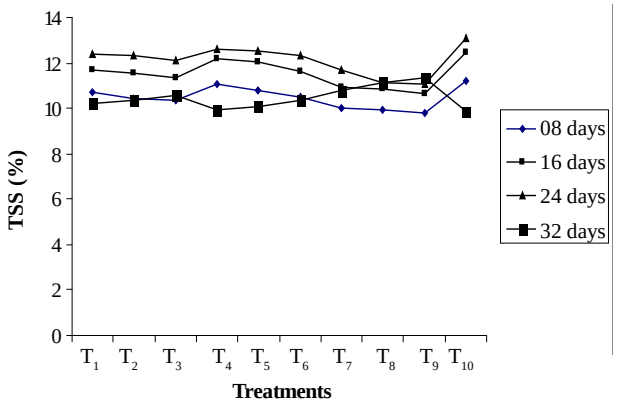
C.D. (P-0.05)
Temperature : 0.22 Storage 0.11 Storage x treatment : 0.49

Fig. 2 : Effect of post-harvest treatments of polyamines on pulp : stone ratio of stored peach fruits

firmness of peach fruits during the cold storage (Kaur, 2011).

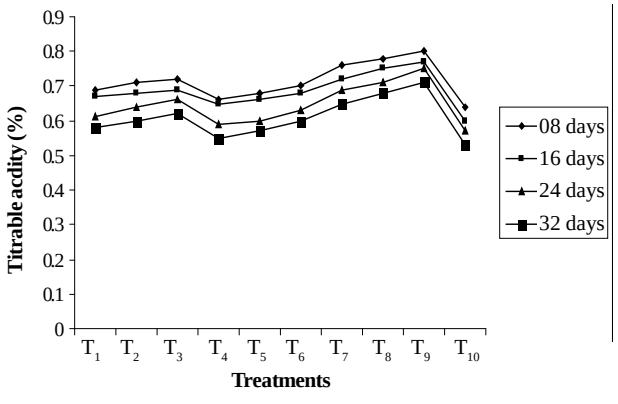
Storage period and treatments displayed a significant effect on the TSS content of peach fruits (Fig. 3). Data revealed that the TSS content in peach fruits increased up to 24 days of storage, after which a decline in TSS was observed by the end of 32 days of storage period except putrescine @ 2 and 3 mmol L^{-1} treatments. The increase in TSS with the progression of storage period may be due to the numerous catabolic processes taking place in the fruits during ripening and senescence processes. The reason for the increase in TSS could be attributed to the water loss and hydrolysis of starch and other polysaccharides to soluble form of sugar. Wills *et al.* (1980) also reported that starch gets hydrolyzed into mono and disaccharides, which in turn may lead to an increase in TSS. The results on TSS in the present studies are in agreement with the findings of Malik *et al.* (2003) who reported a slow increase in total soluble solids in 'Kensington Pride' mango treated with putrescine as compared to control. Ramezanian *et al.* (2010) also reported that spermidine treatments in pomegranate fruits showed lower soluble solid content as compared to control. Khosroshahi and Ashari (2007) found that exogenous application of putrescine in apricot fruit resulted in less TSS content as compared to control.

The titratable acidity of peach fruits showed a linear declining trend with advancement of storage period (Fig. 4). The perusal of data revealed that the maximum titratable acidity was found after 8 days of storage and the minimum titratable acidity was found after 32 days of storage. Results also showed that putrescine treatments had significant effect in retaining the titratable acidity of peach fruit. During the entire storage period, the highest titratable acidity was recorded in putrescine @ 3 mmol L^{-1} treated fruits ranging from 0.80 to 0.71% and the lowest acidity was recorded in control fruits, which ranged between 0.64 to 0.53%. The maintenance of higher acidity in putrescine treated fruits may be due to the decreased hydrolysis of organic acids and subsequent accumulation of organic acids which were oxidized at a lower rate because of decreased respiration. The decrease in titratable acidity during storage may be attributed to utilization of organic acids in pyruvate decarboxylation reaction occurring during the ripening process of fruits (Rhodes *et al.*, 1968 and Pool *et al.*, 1972). Malik *et al.* (2006) reported that fruits treated with polyamines were found more acidic than control in 'Kensington Pride' mango. Kassem and Marzouk (2010) also observed a higher acidity in date palm fruits treated with putrescine as compared to control. Similar findings with regard to slow decline in titratable acidity with putrescine treatments were noticed by Khan *et al.* (2008) in 'Angelino' plum and by Khosroshahi and Ashari (2007) in 'Tokhm-sefid'



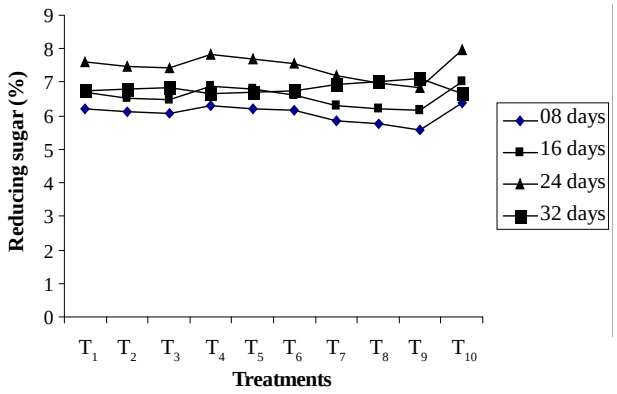
C.D. (P-0.05)
Temperature : 0.20 Storage 0.13 Storage x treatment : 0.40

Fig. 3 : Effect of post-harvest treatments of polyamines on total soluble solids of stored peach fruits



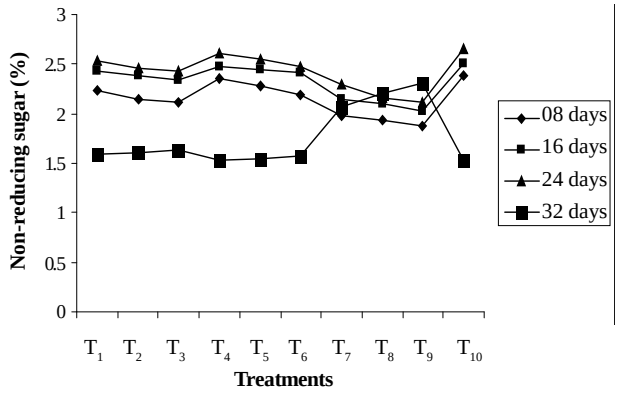
C.D. (P-0.05)
Temperature : 0.04 Storage 0.03 Storage x treatment : 0.09

Fig. 4 : Effect of post-harvest treatments of polyamines on acidity of stored peach fruits



C.D. (P-0.05)
Temperature : 0.13 Storage 0.08 Storage x treatment : 0.26

Fig. 5 : Effect of post-harvest treatments of polyamines on reducing sugars of stored peach fruits



C.D. (P-0.05)
Temperature : 016 Storage 0.10 Storage x treatment : 0.31

Fig. 6 : Effect of post-harvest treatments of polyamines on non-reducing sugars of stored peach fruits

apricot fruits.

Data presented in Fig. 5, indicated an increase in the reducing sugars content of peach fruit with advancement of storage period. It also showed that reducing sugars increased up to 24 days of storage, thereafter, a declining trend was observed in all the treatments except putrescine @ 2 and 3 mmol L^{-1} treatments. On the 8th day of storage, minimum reducing sugars (5.56) were found in putrescine @ 3 mmol L^{-1} treated fruits and the maximum reducing sugars (6.39%) were recorded in fruits kept under control. A similar trend was followed after 16 and 24 days of storage i. e. minimum reducing sugars were estimated in putrescine 3 @ mmol L^{-1} treated fruits and maximum reducing sugars were recorded in untreated fruits. However, after 32 days of storage interval the trend was reversed, the maximum reducing sugars (7.12%) were found in putrescine @ 3 mmol L^{-1} treated fruits, followed by putrescine @ 2 and 1 mmol L^{-1} treatments and the minimum was found in control.

An increase in the content of non-reducing sugars was recorded up to 24th day of storage period, afterwards a decline was recorded except putrescine (2 and 3 mmol L^{-1}) treatments (Fig. 6). On the 8th day of storage, minimum non-reducing sugars (1.88%) were estimated in putrescine @ 3 mmol L^{-1} treatment, followed by putrescine @ 2 and 1 mmol L^{-1} treatments and the maximum non-reducing sugars (2.39%) were found in control fruits. Similarly, after 16 and 24 days of storage, fruits treated with putrescine @ 3 mmol L^{-1} registered minimum non-reducing sugars, while untreated fruits recorded maximum non-reducing sugars. But, after 32 days of storage the trend of non-reducing sugars was also reversed. The increase in sugars during storage may possibly be due to the breakdown of complex organic metabolites into simple molecules or due to the hydrolysis of starch into sugars. The decline in sugar content at the later stages of storage may be attributed to the fact that after the completion of hydrolysis of starch, no further increase in sugars occurs and subsequently a decline in sugars is predictable as they along with other organic acids are primary substrate for respiration (Wills *et al.*, 1980, Prashant and Masoodi, 2009). Malik *et al.* (2003) also reported a slow increase in sugars in 'Kensington Pride' mango fruits treated with pre- and post-harvest application of putrescine as compared to the control.

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