Enhancing Post Harvest Storage Life of Peach Fruits Using Calcium Chloride

[1]MUHAMMAD SOHAIL*, [2]SHAHID AKBAR KHALIL, [1]SHAMSUR REHMAN AFRIDI
[1]REHMAN ULLAH KHAN, [2]TAUFIQ AHMAD AND [3]FARMAN ULLAH
[1]*Food Technology Centre, PCSIR Labs Complex Peshawar, Pakistan.*
[2]*Nuclear Institute for Food and Agriculture (NIFA), Tarnab Peshawar, Pakistan.*
[3]*KPK Agricultural University Peshawar, Pakistan.*
msohail294@gmail.com*

(Received on 21st April 2012, accepted in revised form 3rd November 2012)

Summary: The present study was conducted to enhance the post harvest storage life of peach fruits using calcium chloride treatments. $CaCl_2$ solution at 1 % (T_1), 2 % (T_2) and 3 % (T_3) were prepared and the fruits were dipped for five minutes, while (T_o) was left with out calcium chloride treatment as control. The fruits were packed in corrugated soft board cartons and stored at ambient temperature ($35^oC \pm 2$) for a total period of 15 days. The physicochemical analysis such as weight loss, fruit firmness, total soluble solids (TSS), decay index, titratable acidity, ascorbic acid content and overall sensory acceptability were determined at an interval of three days up to the successful completion of the study. A significant decrease was observed in fruit firmness (1.8-0.3 kg), % acidity (0.950-0.538), ascorbic acid content (7.06-4.67 mg/100g) and overall sensory acceptability (8.4-2.3), while a significant increase was observed in TSS (8.2-11.9^{o}brix), decay index (0-72.64 %) and % weight loss (0-11.3) during storage. Results showed that one and two percent calcium chloride treated fruits have little improvement while fruits treated with 3 % calcium chloride were found to be most acceptable as per physico-chemical analyses and over all sensory acceptability result.

Introduction

Peach *(Prunus persica* L.) is one of the most important fruits grown in the Khyber Pakhtunkhwa (KPK) Province of Pakistan. Besides Peshawar region, peaches are also grown in South Waziristan and Northern areas of Pakistan like Swat, Hazara, Chitral, Gilgit and Hunza [1]. In KPK the post harvest losses of peach fruit recorded by Zeb and Khan [2] were 30 to 40%, that's why it is marketed immediately after harvests.

Peaches are extremely perishable fruits and do not lend themselves to prolonged cold storage. If held too long at or near 0°C they are subjected to chilling injury. The onset of these symptoms determines the post harvest storage potential because chilling injury development reduces consumer acceptance [3].

Several approaches like heat treatment, wax coating, vinyl resin plastic coating, fumigation with ethylene bromide, acid dipping, and use of fungicides have been tried to control the post harvest decay of fruits [4]. These post harvest treatments can help in increasing fruit shelf life, thus reducing commercial losses for packaging houses. Post harvest application of calcium may delay senescence in fruits with no detrimental effects on consumer acceptance [5]. Exogenously applied calcium stabilizes the plant cell wall and protects it from cell wall degrading enzymes. It also reduces fruit softening and increases storage life as compared to untreated fruits [6].

The short post harvest life of fresh peach is a major hurdle in marketing both at national and international levels. So keeping in views the economic importance of the fruit and huge loss due to rot, this experiment was initiated, The purpose of this research work was to extend the shelf life of fresh peach fruit using calcium chloride and to find an economical and effective control measure to minimize the post harvest losses so that it can be shipped to distant markets and thus generate larger revenues for all stake holders. The results of this work are not only highly useful for the farmers but also for the fruit processing industries.

Results and Discussion

Weight loss

The mean values for % weight loss significantly ($P<0.05$) increased from 0 to 11.3% during storage. Maximum mean value was recorded in sample T_o (7.23%) while minimum mean value was noted in sample T_3 (2.25 %) (Fig. 1). Calcium applications are effective in terms of membrane functionality and integrity maintenance which may also be the reason for the lower weight loss found in calcium treated fruits. Amal *et al*. [7] reported that weight loss occurs during storage of fruits due to their respiratory process, transfer of humidity and some processes of oxidation; however the calcium treated fruits significantly reduced the weight loss as

*To whom all correspondence should be addressed.

compared to control. The same results were also found by Mahajan and Dhatt [8] that pear fruit treated with calcium chloride proved to be most effective in reducing weight loss compared to non treated fruit.

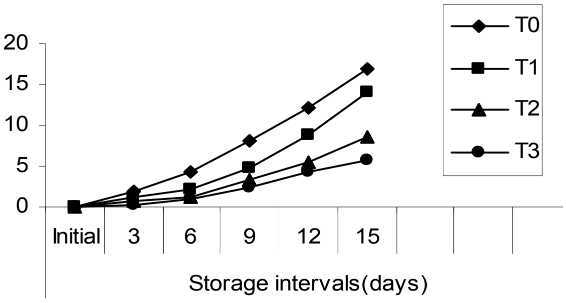

Fig. 1: Effect of calcium chloride and storage intervals on weight loss (%) of peach fruits.

Ascorbic Acid Content

The data pertaining to ascorbic acid content is shown in Fig. 2. Ascorbic acid is an important nutrient quality parameter and is very sensitive to degradation due to its oxidation compared to other nutrients during food processing and storage [9]. A significant decrease ($P<0.05$) in the mean values of ascorbic acid was seen during the storage intervals. However the maximum mean value was recorded in sample T_3 (6.51 mg/100g), while minimum mean value was recorded in sample T_o (5.21 mg/100g). These results showed that $CaCl_2$ treatments had a significant effect on retaining ascorbic acid content in peach fruits. This might be because higher concentrations of $CaCl_2$ delayed the rapid oxidation of ascorbic acid in sample T_3. However the losses in ascorbic acid content may be due to light during storage. The present results are also in agreement with that of Guzman and Barrett [10] who proved that calcium chloride helped in retaining vitamin C in horticultural commodities during storage.

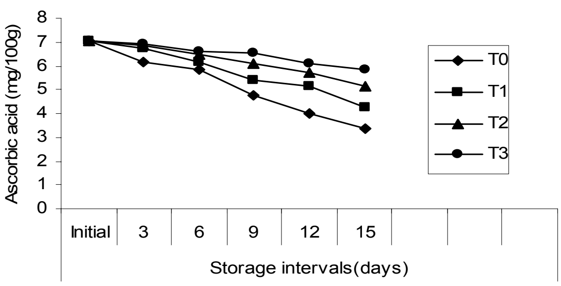

Fig. 2: Effect of calcium chloride and storage intervals on ascorbic acid (mg/100g) of peach fruits.

Fruit Decay Index

The results related to decay index showed that storage intervals and treatments had a significant ($P<0.05$) effect on controlling decay of the peach fruit during storage (Fig. 3). The % decay index of samples (T_o to T_3) on day first was 0% for all samples which were gradually increased to 94.78, 82.33, 67.78 and 45.67 % respectively during the storage period. Maximum mean value was recorded in sample T_o (42.61%) while minimum mean value was noted in sample T_3 (13.17%). High calcium concentrations result in decreased flesh softening which is directly related to calcium content in fruits [11]. Therefore calcium dips raise the possibility of producing fruit less susceptible to decay during storage.

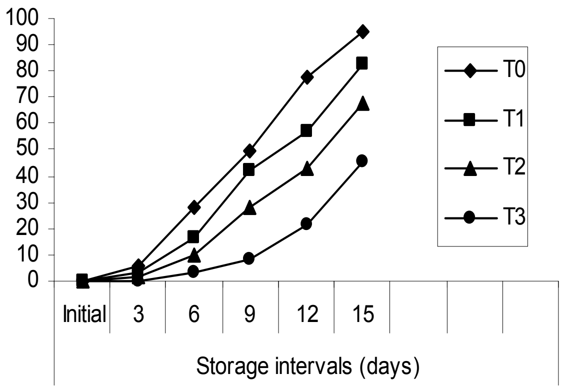

Fig. 3: Effect of calcium chloride and storage intervals on decay index (%) of peach fruits.

Total Soluble Solids

The total soluble solids increased in all samples with the passage of storage time (Fig. 4). Although total soluble solids increased with the increase in storage time, but statistically ($P<0.05$) the treatment results showed negligible difference among the different treatments. However maximum mean value was recorded in sample T_o (10.30%) while minimum mean value was noted in sample T_3 (9.0%). The increase in TSS was probably due to the hydrolysis of polysaccharides and concentrated juice content as a result of dehydration with the passage of storage time [12]. Hermandz-Munoz *et al.* [13] also reported increase in TSS during strawberry storage due to loss of water from fruit surface.

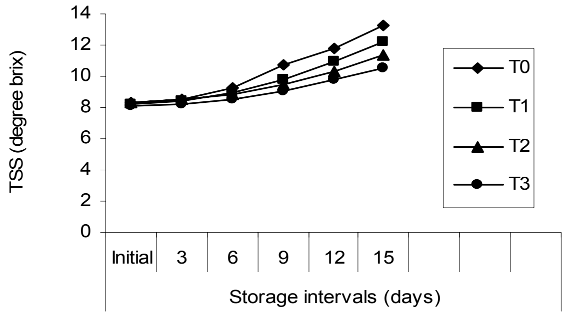

Fig. 4: Effect of calcium chloride and storage intervals on TSS (^{o}brix) of peach fruits.

Fruit Firmness

The maximum and minimum values of fruit firmness at storage intervals for control, T_1, T_2 and T_3 were 1.8-0 kg, 1.8-0.1 kg, 1.9-0.4 kg and 1.9-0.8kg respectively (Fig. 5). The fruit firmness values decreased significantly ($P<0.05$) as we increased the calcium chloride concentration. However in our results 3% $CaCl_2$ treated fruits gave better results as compared to control and 1% $CaCl_2$. Fruit firmness is closely associated with its ripeness stage. As the fruit ripens the fruit softens. But application of calcium chloride helps in reducing the fruit respiration rate thus slows down the ripening process and maintained the fruit firmness. The retention of firmness in calcium treated fruits might also be due to its accumulation in the cell walls leading to facilitation in the cross linking of pectic polymers which increases wall strength [6]. The same results were also noticed by Poovaiah [14] who stated that the favourable effects of calcium chloride in reduction of firmness loss of strawberries during storage may be due to the stabilization of membrane system and formation of Ca- pectate which increased the rigidity of the middle lamella and cell wall.

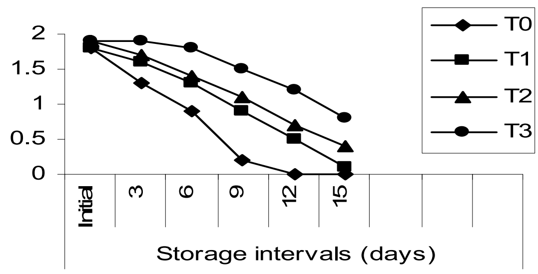

Fig. 5: Effect of calcium chloride and storage intervals on fruit firmness (Kg) of peach fruits.

Titratable Acidity

The Titratable acidity of samples (T_o to T_3) on day first was 0.964, 0.882, 0.961 and 0.993 % which were gradually decreased to 0.416, 0.468, 0.596 and 0.673 % respectively during 15 days storage (Fig. 6). Maximum mean value was recorded in sample T_3 (0.847%) while minimum mean value was noted in sample T_o (0.674%). Titratable acidity decreased slowly in all treatments and it seems to be influenced by the post harvest calcium chloride dips. However it is reduced in T_3 with a slower rate as compared to the other treatments. Therefore calcium chloride is a better tool in maintaining acidity of the fruits after harvesting. Hussain *et al.* [15] have reported a reduction in total acidity during storage. This may be due to the presence of excessive amount of citric acid and malic acid, which are degraded during respiration thus decreasing total acidity of the fruit. However Baritelle *et al.* [16] reported that fruits in which respiration was inhibited, maintained organic acids better during storage as compared to fruits with uninhibited respiration rates.

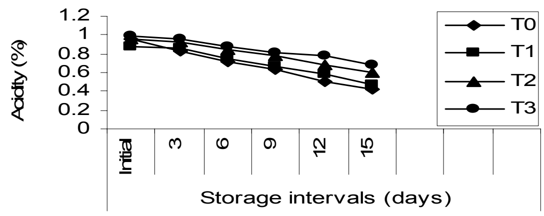

Fig. 6: Effect of calcium chloride and storage intervals on acidity (%) of peach fruits.

Overall Sensory Acceptability

The result of the mean score of judges for overall sensory acceptability is shown in Fig. 7. The maximum and minimum overall acceptability values at storage intervals for control, T_1, T_2 and T_3 were 8.2-0.1, 8.3-0.9, 8.4-2.8, and 8.5-5.3 respectively. At the end of the study the control sample is not in the acceptable range while T_2 and T_3 are in the acceptable range of the 9 point hedonic scale. Because higher concentration of calcium chloride increased the brightness of the fruits. These results are also in agreement with the findings of Rosario [17], who observed that increasing storage time cause progressive degradation, which leads to decrease in overall sensory acceptability. However Ca treated fruits rated superior in appearance, aroma, flavour and texture after harvest but the overall acceptance of the Ca treated fruit continued to be greater than the control fruit.

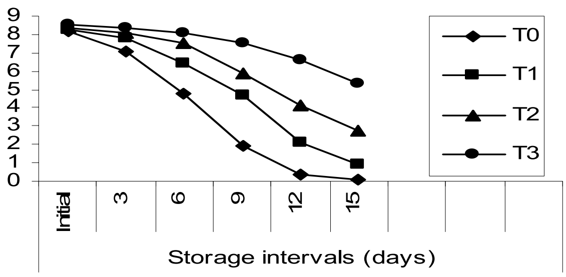

Fig. 7: Effect of calcium chloride and storage intervals on overall sensory acceptability of peach fruits.

Experimental

Selection of Fruits

The study was carried out in the month of July, 2011. Peach fruits not fully matured were manually picked from the local fruit orchard of PCSIR Labs Complex Peshawar Pakistan.

Preparation of Sample

The fruits were divided into four lots (T_o, T_1, T_2 and T_3). T_1, T_2 and T_3 were treated with calcium chloride solution @ 1 %, 2 % and 3 % respectively for 5 minutes. They were surface dried under a fan. One lot (T_o) was left with out calcium chloride treatment as a control. These fruits were then stored in corrugated soft board cartons at ambient temperature (35^{o}C $\pm$ 2) for a total period of 15 days.

Physicochemical Analysis

Evaluation for physicochemical analysis was carried out in Food Technology Centre of PCSIR Labs Complex Peshawar Pakistan. These fruits were assessed initially and after three days interval up to successful completion (15 days) of the study.

Total Soluble Solids

Total soluble solids (TSS) were determined through a refractometer (Abbe Refractometer Model 2WAJ) initially and after 3, 6, 9, 12 and 15 days.

Acidity (%)

Titratable acidity of the treated samples was determined by titration with 0.1 N NaOH. The results were converted to percent citric acid.

Weight Loss

Peach fruits were weighed initially and after 3 days interval during the storage period as described by Wang *et al.* [18]. The percent weight loss was calculated using the following formula:

$$\text{Weight loss (\%)} = \frac{\text{Initial weight- Final weight}}{\text{Initial weight}} \times 100$$

Fruit Firmness

After each three days interval three fruits randomly selected from each lot and their firmness were determined by pressing the knob of the penetrometer into the fruit. The average of these three was the firmness of the whole lot.

Fruit Decay Index (%)

First fruit decay rate was assessed by measuring the extent of decayed area on each fruit, and was determined as: 0, no decay; 1, less than 1/4 decay; 2, 1/4–1/2 decay; 3, 1/2–3/4 decay. Decay index was then determined by the method described by Wang *et al.* [18] using the following formula:

$$\text{\% Decay index} = [(1\times N_1+2\times N_2+3\times N_3) \times 100/ (3\times N)]$$

where N is the total no. of fruits measured and N_1, N_2 and N_3 is the no. of fruits showing the different decay rates.

Ascorbic Acid

Ascorbic acid content of the samples was determined according to the recommended method of AOAC [19] using 2, 6-dichlorophenol indophenol dye. The Ascorbic acid content was calculated as mg /100g of edible portion.

Overall Sensory Acceptability

Samples were organoleptically evaluated for over all sensory acceptability by a panel of 15 experienced judges at the storage interval of 3 days. The evaluation was carried out by using 9 Point Hedonic Scale of Larmond [20].

Statistical Analysis

Data on the above parameters was taken in triplicate and analyzed statistically by using Randomized Complete Block Design (RCBD) while means were separated by Least Significant Difference (LSD) test at 5% level of significance using MSTAT-C software as described by Steel and Torrie [21].

Conclusion

On the basis of results obtained it is concluded that one percent calcium chloride treated fruits did not show any good results. Two percent calcium chloride treated fruits have little improvement, while 3 % $CaCl_2$ retained maximum firmness, TSS, % acidity, ascorbic acid content, overall acceptability and reduced decay index and weight loss as compared to control.

References

1. M. S. Khattak, M. N. Malik and M. A. Khan, *Sarhad Journal of Agriculture*, **18**, 199 (2002).
2. J. Zeb and Z. Khan, *Sarhad Journal of Agriculture*, **24**, 161 (2008).
3. C. H. Crisosto, R. S. Johnson, T. Dejong and K. R. Day, *Journal of Horticultural Sciences*, **32**, 820 (1997).
4. M. Neog and L. Saikia, *Journal of Food Science and Technology*, **47**, 100 (2010).
5. G. E. Laster and M. A. Grusak, *Journal of Horticultural Sciences*, **14**, 29 (2004).
6. P. J. White and M. R. Broadley, *Annals of Botany*, **92**, 487 (2003).
7. S. H. Amal, M. M. Atress, H. E. Elmogy, A. Anean and B. W. Alsanius, *Journal of Horticultural Science and Ornamental Plants*, **2**, 88 (2010).
8. B. V. C. Mahajan and A. S. Dhatt, *International Journal of Food*, *Agriculture and Environment Sciences*, **2**, 157 (2004).
9. R. H. Veltman, R. M. A. Kho, C. R. Van-Schaik, M. G. Sanders and J. Oosterhaven, *Post Harvest Biology and Technology*, **19**, 129 (2000).
10. L. S. J. Guzman and D. M. Barrett, *Post Harvest Biology and Technology*, **19**, 61 (2000).
11. I. G. N. Hewajulige, R. S. Wilson, R. L. C. Wijesundera, M. Abeysekere, *Journal of the Science of Food and Agriculture*, **83**, 1451 (2003).
12. A. Akhtar, N. A. Abbasi and A. Hussain, *Pakistan Journal of Botany*, **42**, 181 (2010).
13. P. Hermandz-Munoz, E. Almenar , V. D. Valle, D. Velez and R. Gavara, *Journal of Food Chemistry*, **110**, 428 (2008).
14. B. W. Pooviah, *Journal of Food Technology*, **40**, 86 (1986).
15. M. A. Hussain, M. Ahmed, M. Khan and I. Shakir, *Pakistan Journal of Nutrition*, **3**, 336 (2004).
16. A. L. Baritelle, G. M. Hyde, J. K. Fellman and J. Varith, *Postharvest Biology and Technology*, **23**, 153 (2001).
17. M. J. G. Rosario, *Journal of Philippine Agriculture Research*, **9**, 201 (1996).
18. Y. Wang, S. S. P. Tian and Y. Xiu, *Journal of Food Chemistry*, **91**, 99 (2005).
19. A. O. A. C, Association of official and analytical chemists. 15th Ed (Helrich, k.). Arlington, Virgina, USA (2000).
20. E. Larmond, Lab Methods of Sensory Evaluation of Food. Pub. Canada Dept Agri Ottawa, p. 9 (1977).
21. R. G. D. Steel and J. H. Torrie, Principles and procedures of statistics. Mc. Graw Hill Pub. Co. Inc. New York, p. 42 (1997).