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Postharvest calcium treatments and storage intervals influencing physico-chemical attributes of peach cv. Shan-e-Punjab

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Abstract

To investigate the impact of different calcium treatments and storage intervals on quality of peach cv. Shan-e-Punjab, a research was conducted at postharvest Laboratory, Division of Fruit Science SKUAST J, during the year 2014–2015. Statistical design used in this experiment was completely Randomized Design (CRD) with factorial arrangement repeated three times. The peach fruits (cv. Shan-e-Punjab) were harvested at colour break stage from peach orchard Udhewala SKUAST-J. The fruits were dipped in 0, 2 4 and 6% $CaCl_2$ solution for 10 ± 5 min and transferred to cold storage having 3±2 °C with relative humidity of 80–85%. The application of post harvest $cacl_2$ treatments and storage intervals significantly influenced the fruit quality of peach fruit. Minimum PLW (10.09%) was observed in fruits treated with 6% $CaCl_2$. Fruit firmness (12.73 lb/inch^2) TSS (13.33 °Brix), sugars (3.45 mg/100g) were increased with the advancement of storage period while as it was also able to maintain specific gravity (1.125) and Titratable acidity (0.67%) of peach fruits. Results showed that two and four percent calcium chloride treated fruits have little improvement while fruits treated with 6% calcium chloride were found to be most acceptable as per physico-chemical analyses and over all sensory acceptability result.

Keywords: Postharvest calcium treatments, physico-chemical

Introduction

Peach fruits after harvesting show rapid increase in the ethylene levels *vizaviz* rapid ripening in turn which reduces the shelf life of fruit and becomes a serious point of concern for proper marketing handling and transportation. Refrigeration in combination with different chemicals are used to retard its ripening processes by cold storage. But with that cold storage life of peaches is almost limited by chilling injury (ci) and loss of quality (Brummell, Dal Cin, Crisosto, & Labavitch, 2004; Valero, Serrano, Martinez Madrid, & Riquelme, 1997) [5, 23]. Various pre and post-harvest factors are responsible for deciding fruit quality of peach fruit. There are various difficult situations through which fruit has to pass while handling, transporting and marketing as well and also having perishable nature which leads to its higher deterioration rates. The postharvest loses occuring in fruits is on higher magnitudes as compared to vegetables. (Serrano *et al.*, 2004) [21]. The relative amount of calcium can be increased by dipping fruits before storing or packing as campared to that done with spraying before harvesting with which fruit injuries can b restricted and it can depend on type of salt used and calcium concentrations. It has been observed by (Garcia, Herrera, & Morilla, 1996; Picchioni, Watada, Conway, Whitaker, & Sams, 1998) [17] that when calcium application is being provided as the postharvest treatment to the peach fruits, it helps in maintaining the turgour pressure of cell, sound firmness of tissues and reduces membrane lipid catabolism thus protects membrane integrity and thereby increasing shelf life of peach. The objectives of this study were to determine the effect of postharvest fruit immersion in different calcium sources and the optimization of calcium concentrations for extending the shelf life of peach cv. Shan-e-Punjab stored under cold storage and ambient temperatures.

Materials and Methods

Harvesting of the fruits peach cv. 'Shan-e-Punjab' was done when the fruit reached at colour break stage. The fruits were obtained from the Research orchards of Division of Fruit Science, Udheywalla, SKUAST-J during 2014-15. Only mature and blemishes free fruits were selected for the study. Immediately after harvest of peach fruit, precooling method was in order to remove field heat before giving chemical dip treatment. The fruits were treated with different concentrations (2, 4 and 6 per cent) of calcium chloride ($CaCl_2$) for 15 minutes. The fruits kept under control conditions were dipped in water for same duration. The fruits were then allowed for air dry to remove the moisture from the fruit surface and packed in Corrugated Fibre Boxes at 3±2 °C and 85-90% RH. Prior to storage, these samples were treated with 1% $KMnO_4$ except fruits kept under control treatment. There were three replications for each treatment. The observations for various physic-chemical characteristics were made at an interval of 3 days.

- **Physiological loss in weight (PLW)**

PLW of stored fruit was calculated by subtracting final weight from the initial weight of the fruits and expressed in per cent.

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

- ***Fruit firmness***

The fruit firmness was measured with the 'Magnes taylor Pressure Tester' (Plunger dia 7/inch). The plunger was held against the surface of the fruit and forced into the fruit with steady pressure to attain the force necessary for breaking the flesh. The fruit firmness was expressed in terms of lb/inch^2.

- ***Total soluble solids (TSS)***

TSS of fresh fruit was determined by using hand refractometer (Erma, Japan) and readings were expressed as degree Brix (^{0}B) at 20^0 C using reference table (Ranganna 1986) [18].

- ***Titratable acidity***

Titratable acidity was determined by titrating a known quantity of sample (10 ml) against standard solution of 0.1 N sodium hydroxide to a light pink colour using phenolphthalein as an indicator. The results were expressed as% citric acid (Ranganna 1986) [18].

- ***Fruit specific gravity***

Specific gravity of fruits was calculated by the following formula:

$$\text{Specific gravity} = \frac{\text{Weight of fruit (g)}}{\text{Volume of fruit (cc)}}$$

- ***Sugars***

Sugars were determined by Lane and Eynon (1923) [15] method as detailed by Ranganna (1995).

Results and discussion

Under ambient conditions, fruits packed in Corrugated Fiber Boxes treated with 0, 2, 4, 6% $CaCl_2$ showed PLW of 25.50, 22.00, 20.50, and 18.40%, respectively on 3 days after storage, while the corresponding losses in refrigerated condition were recorded as 12.08, 11.84, 11.78, 10.09% respectively, after 15 days of storage (Table 1). It is due to the eminent role of calcium in functioning of the cell like cell growth and division (Johnson, 2008) [12] that eventually retained the fruit weight. Similar trend of results was found by Gupta *et al.* (2011) [10] in which the revealed that on treating fruits with 6% $CaCl_2$ showed minimum loss in weight as compared to other treatments. Levy and Poovaiah (1979) [16] also stated that when fruits were treated with $CaCl_2$ maintained the firmness by tissue rigidity and by lowering the enzymatic activity, responsible for lowering disintegration of cellular structure and decreased the gaseous exchange which inturn became beneficial for minimizing the physiological loss in weight. The weight loss of peach fruit was reduced during storage due to the application of calcium as it played an important role in ammonium absorption, with which more photosynthates are produced and more CO_2 intake occurred (Feagley and Fenn, 1998) [6]. The result is also in accordance with the findings of (Hussain *et al*. 2012; Sajid *et al.* 2014; Babu *et al.* 2015 and Sohail *et al.* 2015) [11, 19, 1, 22].

Mean values from table 2 revealed that fruit firmness (kg cm–2) was clearly affected by Storage duration and calcium chloride concentrations. The lower peach fruit firmness (9.55 lb/inch^2) was noted in peach fruits treated with 0% $CaCl_2$ solution, packed in corrugated fiber boxes and stored under ambient conditions which statistically varies from the rest of the treatments while the highest fruit firmness (12.73 lb/inch^2) was recorded in fruits treated with 6%$CaCl_2$ stored in refrigerated conditions after 3rd days and 15 days of storage respectively. Calcium is a major constituent of cell membrane and cell (Johnson, 2008) [12]. Calcium is considered as barrier in the cell wall before cell separation takes place. It strengthens the cell wall by making cross bridges between them (Fry, 2004). Calcium restricts the enzymes to come in contact with cell wall which facilitates in the cross linking of the pectic polymers and consequently reduces the cell wall degradation rates. (White and Broadley, 2003) [25]. Reduction in glactolipid breakdown, increase the rate of sterol conjugation has been observed due to application of $CaCl_2$ treatments as they affect organization cell membrane structure and function during the postharvest life of fruits (Picchioni *et al.*, 1995). The present findings are in close relation to Shirzadeh *et al.* (2011) who reported that the maximum fruit firmness of apple fruit was recorded in fruits treated with 2% Ca as compared to control treatment, while the minimum firmness was recorded in control during 5 month.

Specific gravity is the ratio of weight to volume and with the increase in storage period there is gradual decline in weight and subsequent loss in volume of fruit (Table 3). Not a significant results were found with regard to specific gravity when $CaCl_2$ treatments were applied to fruits but Gangwar and Tripathi (1972) [9] while studying the biochemical changes during ripening during storage of peach cultivar Sharbati reported that specific gravity of fruits decreased from 1.08 to 1.01 as the stage of fruit advanced from immature to ripe. They further reported a decline in fruit weight with ripening of fruit. The result is also in accordance with the findings of Bakshi, *et al.*, 2006, [2] Sakhale *et al.* (2009) [20], Kapse (1993) [14],

Table 4, revealed that those fruits which were not treated with $CaCl_2$ showed an incearment in TSS as the storage intervals advanced whereas it showed a decreasing trend with the increase in concentration of $CaCl_2$ in respective treatments stored under ambient as well as refrigerated storage conditions. The maximum TSS was observed in fruits which were not treated, while minimum was observed in fruits treated with 6% $CaCl_2$ packed in corrugated fibre boxes under both the storage conditions (ambient as well as refrigerated). The increase in TSS may also be due to higher PLW losses in fruits stored under ambient conditions, as a result of which there might be an increase in the concentration of sugars (Sharma *et al.*, 2010). An increase in TSS was also reported by Vanoli *et al*. (1995) [24] and Bakshi and Masoodi (2009) [3] during storage of peach fruits.

Titratable acidity declined with the increament in storage intervals under ambient as well as refrigerated conditions (Table 5). The fruits treated with 6% $CaCl_2$ and packed in corrugated fibre boxes showed more pronounced titratable acidity, while as untreated fruits showed least value under both ambient as well as refrigerated condition. It was also notified that there is a increase in acidity when the concentration of $CaCl_2$ were increased. Titratable acidity was increased with the increase in $CaCl_2$ concentration Therefore calcium chloride is a better tool in maintaining acidity of the fruits after harvesting. Hussain *et al.* (2004) have revealed that there is decline in total acidity during storage. The reason might be 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.* (2001) reported that fruits in which respiration was inhibited, maintained organic acids better during storage as compared to fruits with uninhibited respiration rates. Kakiuchi *et al.* (1981) [13], Venuli *et al* (1995) [24] and Bakshi and Masoodi (2009) [3] also reported a decrease in overall acid level during storage of peach fruit.

In general, an increment in total sugar content with the advancement in storage intervals was found in all the treatments ambient as well as refrigerated conditions whereas it showed that with the increase in concentration of $CaCl_2$ there was decrement in sugar content in all the treatments (Table 6). Maximum total sugar content was recorded in fruits which were untreated while minimum reducing sugar content was recorded in the fruits treated with 6% $CaCl_2$ under both the storage conditions (ambient as well as refrigerated) this might be due to release of sugar during starch hydrolysis. The amounts of total sugar content in calcium treated fruits lowered due to less transpiration and respiration losses, which resulted in slower hydrolysis of polysaccharides to monosaccharides (Tingwa and Young, 1974). The amount sugars are raised during storage which is due loss of starch during the storage intervals, while apple fruits treated with calcium lowered the increase of total sugars (Bidabe *et al.*, 1970) [4].

Conclusion

Conclusively, the results obtained in this work revealed that fruits treated with calcium chloride as postharvest treatments, is efficient method for extending the shelf life of peach fruits cv. Shan-e-Punjab. The most effective treatment in maintaining fruit quality was 6% $CaCl_2$ along with 1% KMnO4 as an ethylene absorbant during cold storage period at 3$\pm$2 °C and 85–90% RH.

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