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Effect of low temperature and calcium applications on the post harvest quality of peach

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ABSTRACT

Peach is highly perishable and climacteric fruit, it loses its quality in a very short time after harvesting. Fruits of peach varieties matures in the hot months (end April to first week of May) and high temperature & low humidity during this period leads to heavy post-harvest losses. To reduce these losses physiologically mature fruits of *cv.* Shan-i-Punjab were dipped for five minutes in aqueous solutions of $CaCl_2$ and $Ca(NO_3)_2$ at three concentrations (1.0%, 2.0% and 3.0%). Treated fruits were packed in CFB boxes before cold storage (0-1^{0}C, 90 -95% RH). Results revealed that calcium treatments reduced the fruit weight loss, spoilage and retained the high fruit firmness, sensory quality, total soluble solids and acid content as compared to untreated fruits during the 30 days of storage. Among the various treatments, fruits treated with $CaCl_2$ @ 2% maintained the best quality at the end of storage (after 30 days of storage) with minimum spoilage and weight loss.

***Key words** : Peach, Storage, Calcium and Quality*

Introduction

Peach is an important temperate stone fruit. It occupies the position next to apple and pear in the temperate regions of the world. Although being a temperate fruit peach has high chill requirement, but some low chill varieties are also adaptive to the subtropical regions. In Punjab, with the introduction of low chill peach varieties from United States peach industry is boosted. Shan-i-Punjab, Florida Prince, Early grande, Prabhat and Pratap are the main varieties grown in the state. Among all these cultivars Shan-i- Punjab occupies the maximum area due to high yield potential and superb quality. Fruits of this cultivar ripens in the month of May and high temperature & low humidity during this period leads to heavy post-harvest losses. Peach is a climacteric fruit & highly perishable in nature and it is very difficult to maintain the quality of peach fruits at ambient conditions after harvesting. In India major portion of production is consumed as fresh fruit. During fruiting season there is glut in the market resulting in price crash and low returns to the growers. Therefore, it is necessary to store the produce for stabilizing the market prices. Serrano *et al.,* (2004) stated that fruit shelf-life can be extended by optimization of environmental conditions, minimization of mechanical damage, application of food additives in the form of chemical sprays or dips or by ionizing radiation. The use of post-harvest chemicals ranging from fungicides and fumigants to sprout suppressants and antioxidants, has allowed a considerable extension of the storage life of many fruits. Calcium nutrition of fruits has received considerable attention, because low level of calcium in fruit has been associated with poor keeping quality and increased rate of softening in many fruit species (Poovaiah *et al.,* 1988). Treatment of fruits with calcium compounds to reduce post-harvest losses have proven to be effective by delaying fruit ripening and degradation caused by hydrolyzing enzymes (Dundar *et al.,* 1997). Calcium is known to

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strengthen the structure of cells by maintaining the fibrilar packaging in the cell walls thus reinforcing the cell to cell contact which is related to the formation of calcium pectate and counteracts the pectin methyl esterase activity as observed in calcium treated pear fruits (Alandes *et al.*, 2009). It also acts as anti-senescent agent by preventing cellular disorganization by maintaining protein and nucleic acid synthesis (Scott and Wills, 1975). Keeping these facts in view an experiment was conducted to study the effect of post-harvest applications of calcium chloride and calcium nitrate on the storage life and quality of peach fruit under low temperature conditions.

Materials and Methods

The experiment was carried out on peach *cv.* Shan-i- Punjab during the years 2010 to 2012 (three years) in the Post-Harvest Laboratory of Department of Fruit Science, Punjab Agricultural University, Ludhiana. Healthy, uniform and unbruised fruits were harvested at the physiological maturity in the first week of May. Selected fruits were subjected to seven post- harvest dip treatments (T_1-$CaCl_2$ (1%), T_2- $CaCl_2$ (2%), T_3- $CaCl_2$ (3%), T_4- $Ca(NO_3)_2$(1%), T_5- $Ca(NO_3)_2$(2%), T_6- $Ca(NO_3)_2$(3%), T_7–Control) for five minutes, whereas control fruits were dipped in water only. After shade drying fruits were packed in CFB boxes and kept at 0-1°C and 90-95% RH for 30 days. Fruit samples were analysed for various physico-chemical characteristics on 0, 10, 20 and 30th day of storage. The physiological loss in weight of fruits was calculated on initial weight basis. The per cent loss in weight after each storage interval was calculated by subtracting final weight from the initial weight of the fruits and then converted into percentage value. A nine point 'Hedonic Scale' described by Amerine *et al.*, (1965) was used for sensory quality inference. Firmness of randomly selected fruits was measured with the help of fruit pressure tester (Model FT- 327, USA). The spoilage percentage of fruits was calculated on number basis by counting the spoiled fruits in each replication and total number of fruits per replication. Total soluble solids (TSS) were determined from the juice with the help of hand refractometer (Model Erma, Japan) and expressed in per cent. Fruit acidity was estimated by following AOAC (1990) method. Fruit calcium content was estimated after 24 hrs of treatments on dry weight basis by atomic absorption spectrometer (AANALYST 200, *Perkin Elmer*). The average of three year (2010-2012) data was analyzed by Completely Randomized Block Design (Factorial) as described by Singh *et al.*, (1998).

Results and Discussion

The physiological loss in weight (PLW) increased significantly with the advancement of storage period (Fig 1). A significant difference in weight loss was recorded among all the treatments. After 10 days of storage, minimum PLW was recorded in $CaCl_2$ @ 2% treated fruits as compared to other $CaCl_2$ and $Ca(No_3)_2$ treatments and maximum was observed in control fruits. Similar trend was noticed after 20 and 30 days of storage. Reduction in weight loss by calcium treatments was due to prevention of cellular disintegration by maintaining protein and nucleic acid synthesis (Faust and shear 1972) and low respiration rate (Lougheed *et al.*, 1979). Gupta *et al.*, (2010) also recorded the minimum physiological loss in weight in peach *cv.* Early Grande treated with different calcium treatments.

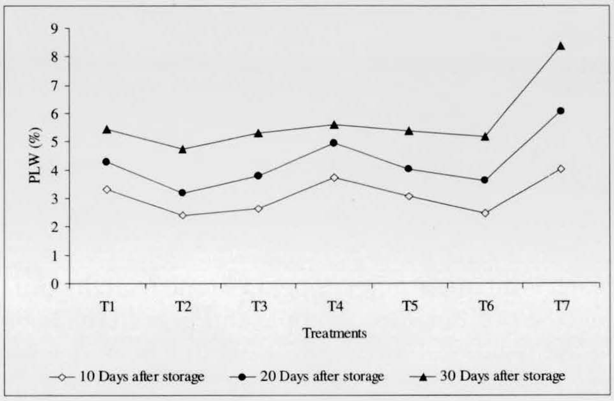

Fig. 1. Effect of post- harvest treatments on PLW of cold stored peach fruits

Sensory quality of fruits improved with storage up to 10 days in all treatments, but after 20 days of storage a decline was recorded in $CaCl_2$ @ 1% and 3%, $Ca(No_3)_2$@1% and 2% treated and control fruits (Fig 2). After 30 days of storage, all the treatments showed a reduction in sensory quality and among all the treatments maximum sensory quality was retained by $CaCl_2$ @ 2% treated fruits. Being a climacteric fruit, its quality was improved during the early days of storage. The higher sensory quality rating of calcium treated fruits at the end of storage might be due to the retardation of ripening and softening process of fruit that led to the development of

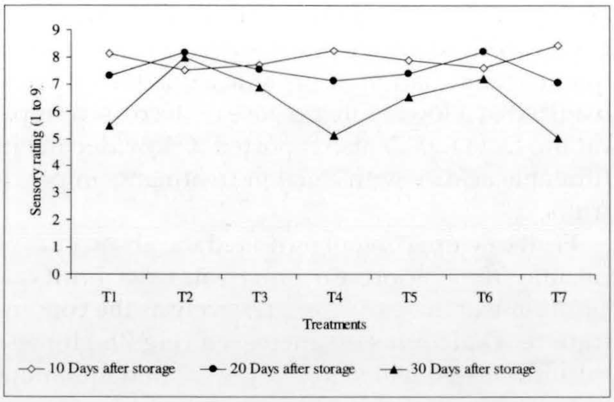

Fig. 2. Effect of post- harvest treatments on sensory quality of cold stored peach fruits

better juiciness, texture, flavour and sweetness. Similarly, Kaundal *et al.*, (2000) noticed high palatability rating in calcium chloride treated plum fruits.

Fruit firmness is the major factor which attributes to the sensory quality of fruits. A decline in fruit firmness was observed with the advancement of storage period in all the treatments (Fig 3). At all the storage intervals, $CaCl_2$ @ 2% treated fruits retained the maximum fruit firmness, whereas minimum was observed in untreated fruits. Softening of fruits is caused either by the breakdown of insoluble protopectins into soluble pectins or by the cellular disintegration leading increased membrane permeability (Matoo *et al.*, 1975). Calcium compounds could have significantly increased the firmness of fruits by thickening of middle lamella of fruit cells owing to increased formation and deposition of calcium pectate (Gupta *et al.*, 1984). The Ca^{++} rigidities and stabilizes the cell membranes. A slow decline in flesh firmness with advancement of storage period

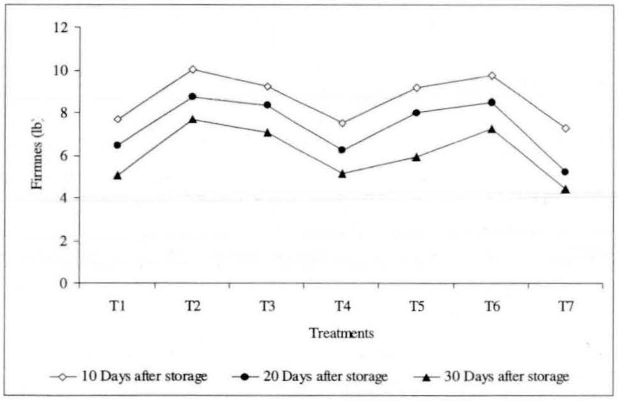

Fig. 3. Effect of post -harvest treatments on firmness of cold stored peach fruit

by calcium treatments has also been observed in plum cv. Satluj Purple as compared to control (Mahajan and Dhatt, 2004).

Calcium treatments showed a significant effect on the reduction of fruit spoilage during storage. After 10 days of storage, no spoilage in fruits was recorded in all the treatments, but after 20 days of storage only $CaCl_2$ @ 2% and $Ca(No_3)_2$ @ 3% treatments showed no spoilage. At the end of storage all the treatments showed the significant fruit spoilage (Fig 4). During the entire storage period, minimum spoilage was recorded in $CaCl_2$ @ 2% treated fruits. An increase in the calcium content of fruits has been associated with decreased incidence of physiological disorders, improved storage life, reduced severity of bacterial and fungal rots (Rease 1986; Conway and Sams, 1994), as calcium is known to impart resistance against the attack of infectious pathogens (Bangreth *et al.*, 1972). Calcium increases the synthesis of phytoalexins and phenolic compounds which are involved in resisting the fungal attack and it also reduces the risk of micro cracks in the cuticle which is known as the direct site of fungal infection (Elmer *et al.*, 2000).

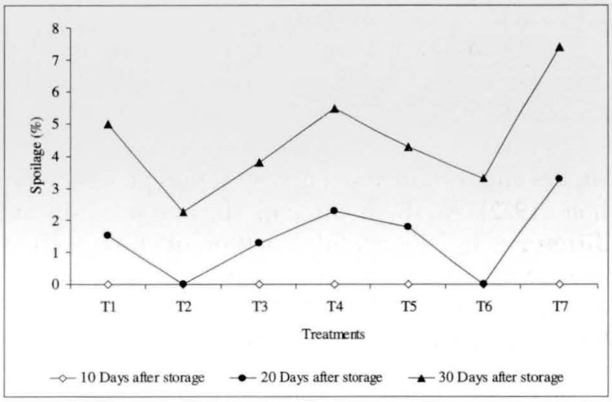

Fig. 4. Effect of post -harvest treatments on spoilage of cold stored peach fruits

The rate of increase in total soluble solids content indicates the rate of ripening. An increase in total soluble solids was recorded in all the treatments up to 20 days of storage, but after 30 days of storage this increase was recorded only in $CaCl_2$ @ 2% and $Ca(No_3)_2$ @ 3% treatments and a decline was recorded in all other treatments (Fig 5). A steady increase in TSS was recorded in calcium treated fruits and at the end of storage maximum TSS contents were retained by $Ca(No_3)_2$ @ 3% and $CaCl_2$ @ 2%

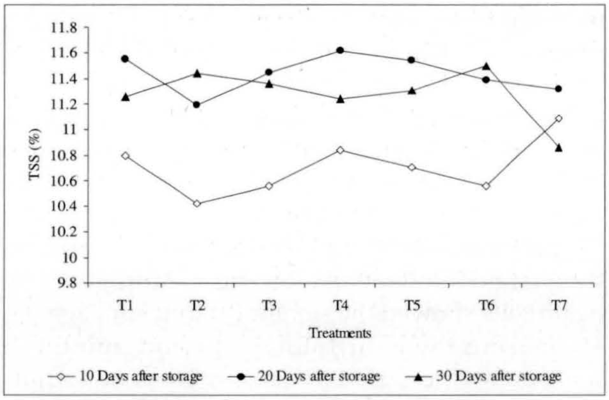

Fig. 5. Effect of post- harvest treatments on TSS of cold stored peach fruits

treatments. 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 content. According to Rease and Drake, (1993) apple and pear fruits had higher TSS content, during cold storage as compared to control, when treated with calcium chloride during storage.

Acid content of fruits declined with ripening, a decrease in fruit acidity was recorded with an increase in storage period (Fig 6). Such a decrease in acidity has been attributed to conversion of acids to sugars and its utilization in respiration process (Pool *et al.*, 1972). All the treatments showed a significant difference in fruit acidity at different storage intervals. During the entire storage period, highest acidity was recorded in $CaCl_2$ @ 2% treated fruits and lowest in control fruits. The maintenance of higher

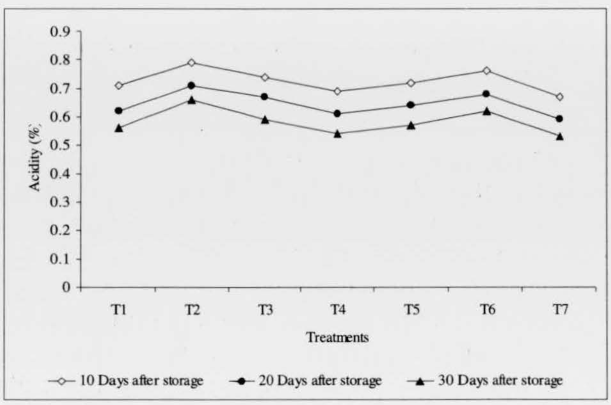

Fig. 6. Effect of post- harvest treatments on acid content of cold stored peach fruits

acidity in calcium 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. Devi (2007) also reported a slow decline in titratable acidity with calcium treatments in peach fruits.

Fruit calcium content indicated the absorption of calcium from various calcium treatments. Fruit calcium content increased progressively as the concentration of calcium salts increased (Fig 7). Highest calcium was estimated in $CaCl_2$ @ 3% and minimum in control fruits, but a non- significant difference in calcium content was recorded in $CaCl_2$ @ 2% and $CaCl_2$ @ 3% treated fruits. According to Jawandha *et al.*, (2009) the higher level of calcium in treated fruits was due to greater absorption and higher deposition of calcium in higher concentrations than lower.

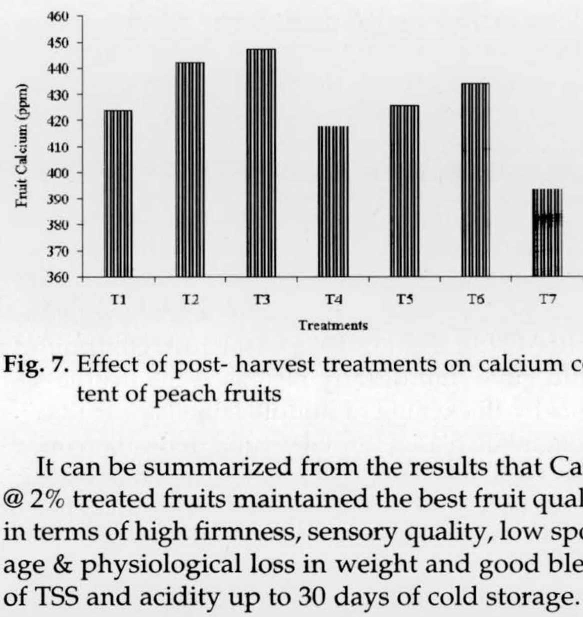

Fig. 7. Effect of post- harvest treatments on calcium content of peach fruits

It can be summarized from the results that $CaCl_2$ @ 2% treated fruits maintained the best fruit quality in terms of high firmness, sensory quality, low spoilage & physiological loss in weight and good blend of TSS and acidity up to 30 days of cold storage.

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