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Effect of chemicals and packaging on quality of mango fruits under cold storage

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ABSTRACT : Mango is a climacteric fruit and highly perishable in nature. To maintain the post-harvest quality in mango cv. Langra, fruits were treated with calcium chloride (2.0, 4.0 %) and gibberellic acid (100, 200 ppm) or combined with LDPE packaging. Treated fruits were placed in CFB boxes and subsequently stored at 13±1^{0}C with 90-95% RH for 34 days. The effectiveness of treatments in extending fruit shelf life was evaluated by determining fruit firmness, TSS, acidity and vitamin C content. All LDPE packed fruits maintained higher fruit firmness as compared to non LDPE treatments and control. TSS contents improved throughout storage in LDPE treatments while in others these increased sharply up to 27 days and then a decline was noticed. Various treatments delayed reduction of acid and vitamin C contents during storage over the control. Results indicated that calcium chloride @ 2% + LDPE treatment were found significantly effective in maintaining firmness, total soluble solids, titratable acidity and retaining more ascorbic acid at the end of the storage.

KEY WORDS : Mango, $CaCl_2$, LDPE packaging, Low temperature storage, Fruit quality

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Mango (*Mangifera indica* L.) is one the most important tropical fruit and India is the global leader in mango production. Mangoes like other climacteric fruits are highly perishable in nature and can hardly be stored for a week at ambient conditions (Kalra and Tandon, 1983). Under sub-tropical conditions the mango matures during hot weather and fruit cannot kept for long period. In peak harvesting season mango produce is subjected to heavy post harvest losses due to glut in the market. This problem becomes even more acute during the "on year". Extension in storage period of mango and other fruits has successfully been reported with use of plant growth regulators, chemicals, minerals, vegetable oils, wax emulsions and wrappers (Abbasi *et al*., 2009 and Abbasi *et al.,* 2011). The modified atmosphere packaging positively affected the physiological and chemical quality of mangoes during storage (Tefera *et al.,* 2007). Treatment of fruits with calcium compounds to reduce post-harvest losses has proven to be effective by delaying fruit ripening and degradation caused by hydrolyzing enzymes (Dundar *et al.,* 1997). Under subtropical conditions of north-westren India, limited work has been done on effect of calcium and GA_3 dip application with LDPE packaging on quality of mango under low temperature storage. Keeping the above facts in view, the present investigation was, therefore, undertaken to compare the effect of post-harvest applications of calcium chloride and gibberellic acid with or without LDPE packaging on the keeping quality of mango fruits under low temperature conditions.

RESEARCH METHODS

Fresh, physiologically mature and uniform in size mango fruits cv. Langra were picked from College Orchard, Department of Fruit Science, Punjab Agricultural University, Ludhiana during the year 2012. The harvested fruits were immediately shifted to the Post Harvest Laboratory of the Department. The bruised and diseased fruits were sorted out and healthy fruits were washed and air dried at room temperature. A total of nine treatments were given comprising three replications in each treatment. T_1 ($CaCl_2$ 2%), T_2 ($CaCl_2$ 4%), T_3 (GA_3 100 ppm), T_4 (GA_3 200 ppm), T_5 ($CaCl_2$ 2% + LDPE packaging), T_6 ($CaCl_2$ 4% + LDPE packaging), T_7 (GA_3

100 ppm + LDPE packaging), T_8 (GA_3 200 ppm + LDPE packaging), T_9 (Control). The experiment was laid out in a Completely Randomized Design. The fruits were given dip in aqueous solutions of $CaCl_2$ and GA_3 for five minutes. The treated fruits were air dried under shade before LDPE (40 micron with 0.1% perforation) packaging. The fruits were placed in CFB boxes and subsequently stored at 13 ± 1^0C with 90-95% RH for 34 days. The physico-chemical characteristics of fruit samples were analyzed on the day of harvesting and after 10, 20, 27 and 34 days of storage. Firmness of randomly selected fruits (three from each replication) was measured with the help of fruit pressure tester (Model FT- 327, USA). About one square centimeter of the skin in each fruit from the shoulder end on both sides was removed with the help of peeler and firmness of pulp was recorded and expressed in terms of kg/cm^2. Total soluble solids (TSS) were determined from the juice at room temperature with the help of hand refractometer (Model Atago, Japan) and expressed in per cent. The readings were corrected with the help of temperature correction chart at 20^0 C temperature. Acidity was estimated by titrating 2 ml of strained 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. Ascorbic acid was determined by the 2, 6-dichlorophenol indole titration method (AOAC, 1995).

RESEARCH FINDINGS AND DISCUSSION

The texture is a critical quality attribute in the consumer acceptability of fresh fruits. The fruit firmness decreased with progressive increase in storage period in all the treatments (Fig. 1). The fruit firmness decreased at faster rate after 27 days of storage, especially in non-LDPE treatments. The $CaCl_2$ @ 2% + LDPE packaging treatment was best in maintaining fruit firmness throughout the storage period which was followed by GA_3 200 ppm + LDPE packaging treatment while the minimum fruit firmness was recorded in control fruits. All LDPE packaging treatments registered higher fruit firmness as compared to respective non LDPE treatments. These results corroborate the earlier findings of Ben-Yehoshua (1985) who reported that sealing individual climacteric fruit in low-density polyethylene bags delayed ripening and softening of fruits and hence, improved marketability. $CaCl_2$ (2%) dips treatments improved maintenance of fruit firmness followed by GA_3 200 ppm compared to control treatment, but these were less effective than with combination of LDPE treatments. The $CaCl_2$ treatments avoided softening and maintained the structures of cell walls through cross-linking the pectic acid in the cell wall (Gunes *et al.,* 2001). Similar response was also reported by Hojo *et al.* (2009) who found that calcium is known to delay senescence resulting in firmer mango fruits.

Changes in total soluble solids as effected by various post harvest treatments are shown in Fig. 2. LDPE packed fruit recorded significantly lesser total soluble solids content than fruits given chemical treatments only. However, TSS contents in all LDPE treatments improved with storage time whilst in other treatments it increased up to 27th day followed by decline at the end of storage. This change was more apparent in untreated control fruits. Though, the control fruits recorded highest total soluble solids content after 27 days of storage. The excessive increase in TSS of mangoes during storage is an indication of quality deterioration (Pal and Roy, 1988). Kader *et al.* (1989) reported that the role of packaging was primarily to reduce the respiration rate of fruit and vegetables by retarding their metabolic activities. Reduced respiration also retards softening and slows down various compositional changes such as TSS, which are associated with ripening. After 34 days of storage, maximum TSS contents were retained in $CaCl_2$ (4%) + LDPE packed fruits and minimum in control fruits. Present results are in

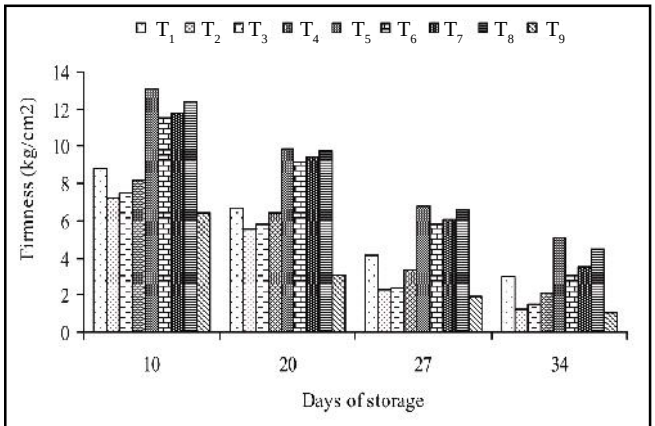

Fig. 1 : Effect of post-harvest treatments on firmness of mango fruits under cold storage

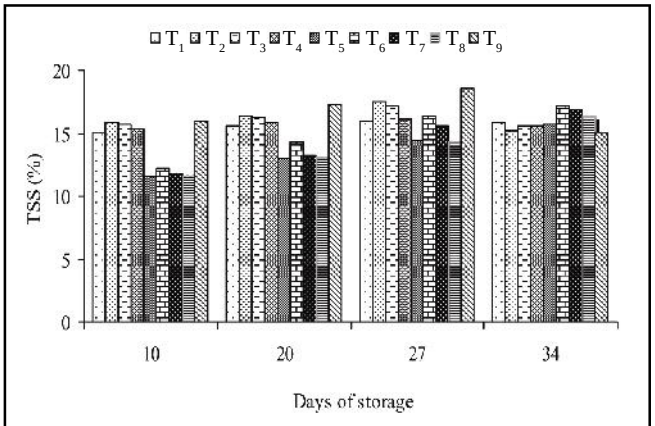

Fig. 2 : Effect of post-harvest treatments on TSS contents of mango fruits under cold storage

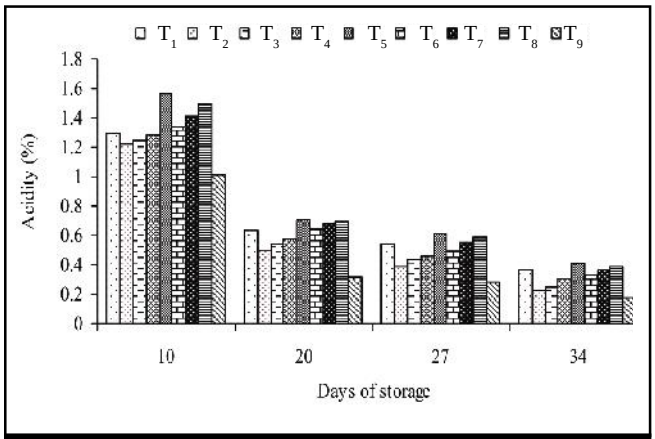

Fig. 3 : Effect of post-harvest treatments on acidity of mango fruits under cold storage

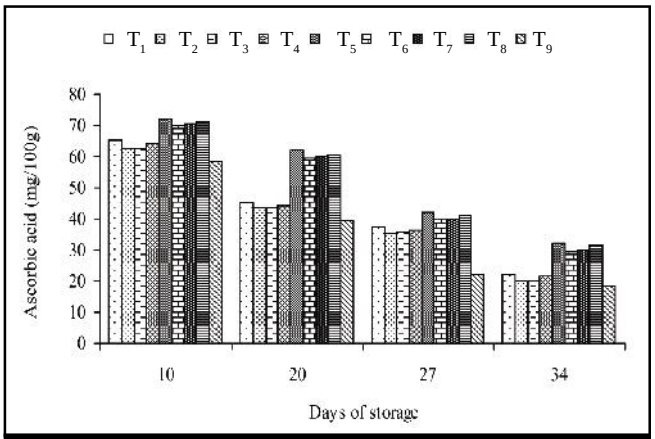

Fig. 4 : Effect of post-harvest treatments on ascorbic acid of mango fruits under cold storage

line with that obtained by Singh *et al.* (1967) who reported a delayed and sustained increase in the total soluble solids in polythene packed fruits of 'Dusehri' mango.

In general the acid content of fruits declined with storage in all the treatments but it was sharper after 10th day of storage (Fig. 3). Comparatively, more acid content was noticed in fruits under LDPE packaging treatments. Highest acid content was recorded in $CaCl_2$ (2%) + LDPE packaging followed by 200 ppm GA_3 with LDPE packaging while the minimum level of juice acids were found in control. Higher acidity in $CaCl_2$ (2%) + LDPE packaging fruits may be attributed to slower utilization of organic acids in oxidative process because of slow rate of respiration. The delay in the reduction of acidity in film wrapped mango fruits as found in the present study confirms the earlier findings of Kalra *et al.* (1986) in 'Dusehri' mango. Post harvest dips of mango fruits in aqueous solutions of $CaCl_2$ and GA_3 solutions were also effective in retaining juice acidity over control. Similar results were reported by Jain and Mukherjee (2011) and (Sudhavani and Sankar, 2002) in mango.

The effect of post harvest calcium chloride and GA_3 with or without LDPE packaging treatments on ascorbic acid content of mango fruits is shown in Fig. 4. Ascorbic acid content decreased gradually with advancement of storage period. However, the retention of ascorbic acid was significantly higher in treated fruits as compared to untreated fruits throughout the storage period. At the end of the storage period maximum ascorbic acid was found in fruits treated with $CaCl_2$ (2%) + LDPE followed by GA_3 200 ppm with LDPE packaging treatment and the control fruit recorded lowest ascorbic acid content. This could be due to retardation of oxidation process and consequent slow rate of conversion of L- ascorbic acid in to dehydroascorbic acid (Jain and Mukherjee, 2011). These results are in line with the findings of Tefer *et al.*, 2007 in mango. Hence, based upon the present studies, it can be concluded that $CaCl_2$ @ 2% + LDPE packaging treatment markedly improved storage life of mango by maintaining fruit firmness and inhibiting senescent changes.

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