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Short communication

Enzymatic and physico-chemical changes in pear fruits in response to post-harvest application of oxalic acid

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ABSTRACT

To study the effect of oxalic acid (OA) on storage behaviour of 'Nijisseiki' pear, fruits were dipped in aqueous solutions of OA @ 2, 4 and 6 mmoll^{-1} for 5 min. Treated and untreated fruits were packed in corrugated fibre board (CFB) boxes and stored at 0-1°C and 90-95% RH. Fruits were analyzed for various physico-chemical changes after 0, 30, 50 and 70 days of storage. As compared to control, OA treatments were found effective in decreasing physiological loss in weight (PLW), spoilage and maintained the fruit firmness, sensory quality, total soluble solids (TSS), titratable acidity (TA), and pectin methyl esterase (PME) activity under low temperature storage. After 70 days of storage, minimum PLW (5.95%), spoilage (3.85%), and maximum fruit firmness (6.95 lbf), TSS (12.19%), TA (0.209%), sensory quality score (5.76) and PME activity (1.29 ml of 0.02 N NaOH) was registered in OA @ 6 mmoll^{-1} treated fruits.

Key words: Oxalic acid, pear, physico-chemical changes, storage.

Pear is one of the important temperate fruits that can be successfully grown under sub-tropical conditions of Punjab because of its wider climatic and soil adaptability. 'Nijisseiki' is recently released variety of pear under local conditions and fruits of this variety are russet brown in colour with soft-pulp. Fruits are harvested during end of June to first week of July when weather is hot and humid, which leads to heavy post-harvest losses. Therefore, there is a need to contrive a suitable technique that could reduce the after harvest losses and maintain the quality of the fruits during storage. Many storage techniques have been developed so far to extend the post-harvest shelf-life of fruits. Recently, application of OA as post-harvest treatment in fruits has received considerable attention. It is an organic acid occurring naturally in plants and fungi and is reported to maintain the membrane integrity and delaying fruit ripening process (Tarabih, 8). Oxalic acid maintained titratable acidity, soluble solids concentration and fruit firmness by reducing activities of cell wall hydrolyzing enzymes (Kant *et al.*, 4). However, information on effect of oxalic acid on storage behaviour of sub-tropical pear fruits is lacking. Therefore, the present experiment was conducted to study the effect of oxalic acid in increasing the post-harvest life of fruits of pear cv. Nijisseiki during low temperature storage.

Physiological mature, healthy and uniform fruits of pear cv. Nijisseiki were picked from the Fruit Research Farm, PAU Ludhiana and were immediately transported to Post Harvest Laboratory. Fruits were dipped in oxalic acid solution @ 2, 4 and 6 mmoll^{-1}, for 5 min. Control fruits were given water dip only. Fruits were air-dried, packed in CFB boxes with 5% perforation and stored at 0-1°C and 90-95% RH. Fruits were analyzed for various physical and chemical changes at 0, 30, 50 and 70 days of storage. The PLW of stored fruits was calculated by subtracting final weight from the initial weight of the fruits and expressed in per cent. Firmness of fruits was measured with the help of a stand mounted penetrometer (Model FT-327, USA) using stainless steel probe with 8 mm plunger after removal of a piece of peel from opposite points on the fruit's equator and expressed as lbf. The fruits were evaluated for sensory quality and rated by panel of five judges on the basis of appearance; taste and flavour using 9 point Hedonic scale (1-9) as described by Amerine *et al.* (1). The spoilage was calculated as the number of spoiled fruits divided by total number of fruits multiplied by hundred and expressed in percentage (%). For the determination of TSS, the fruits were grated and extracted juice obtained was filtered through a cheese cloth. TSS was measured by using digital refractometer (Atago, PAL-1, model 3810, Japan) and expressed in (%). Titratable acidity was calculated by titrating two ml of strained juice against 0.1 N NaOH solution using phenolphthalein as an indicator and expressed in percentage (%). The pectin methyl esterase activity was determined as per method described by Mahadevan and Sridhar (5). Treatments were arranged as a factorial (factors: treatments and storage intervals) experiment in completely randomized design with three replications for each treatment and every replication comprised

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of 20 fruits. The data were analyzed for analysis of variance using statistical software SAS 9.3 (SAS Institute Inc., Cary, NC, USA).

Loss in weight of fruits increased with advancement of storage period irrespective of the treatments applied (Fig. 1a). The PLW occurred at faster rate during first 30 days of storage in all the treatments then a steady increase up to 50 days was recorded. During entire storage period, the minimum weight loss was noted in the fruits treated with oxalic acid @ 6 mmoll^{-1} and the maximum was recorded in control fruits. The low weight loss in fruits treated with oxalic acid might be due to decreased ethylene production which delays the ripening process (Huang *et al*., 2). A significant decrease in fruit firmness was observed with the advancement of storage period for all the treatments (Fig. 1b). By the end of storage, maximum fruit firmness of 6.95 lbf was retained by the fruits treated with oxalic acid @ 6 mmoll^{-1} and the minimum (6.0 lbf) was recorded for control fruits. Razzaq *et al*. (7) also reported the reduction in fruit softening by application of oxalic acid during ripening and storage of mango fruit. The sensory quality of fruits improved up to 30 days of storage in all the treatments followed by a decline up to end of storage. This improvement was highest in control fruits which recorded sensory quality score of 8.12 after one month storage. However, after 50 days of storage, significantly higher (7.65) sensory quality rating was recorded in OA @ 6 mmoll^{-1} treated fruits as compared to control (6.0) fruits. The results are in agreement with the findings of Marboh *et al.* (6) who stated that oxalic acid treated fruits retained good sensory and quality attributes during cold storage. After one month of storage, the control fruits showed spoilage of 1.62%, while oxalic acid treated fruits did not showed any spoilage (Fig. 1d). At succeeding interval (50 days), spoilage in fruits was noticed in OA @ 0, 2, 4 mmoll^{-1} treated fruits. Similarly, at the end of storage studies, significantly lower spoilage of 3.85% was recorded in OA @ 6 mmoll^{-1} treated fruits, while it was maximum (6.70%) in untreated fruits. Oxalic acid treatment extends the storage time and decreases decay of mango fruits due to its fungistatic action (Zheng *et al*., 9). Total soluble solids content of oxalic acid treated fruits increased upto 50 days of storage and subsequently steadily declined (Fig. 1e). However, in control fruits a sharp increase in TSS content was observed and reached maximum (14.15%) after 30 days of storage followed by a decline, which was prominent after 50 days of storage. The decline in TSS might be due to its utilization in evapo-transpiration and other biochemical activities (Marboh *et al*., 6). Regardless of treatments applied, TA of stored pear fruits decreased with the advancement of storage period (Fig. 1f). At the end of storage the significantly higher TA of 0.209% was observed in fruits treated with oxalic acid @ 6 mmoll^{-1} as compared to control fruits, which recorded minimum TA of 0.152%. The PME activity of fruits increased up to 30 days of storage and it was recorded significantly higher (1.76 ml of 0.02 N NaOH) in control fruits (Fig. 1g). After 50 days of storage, a decline in PME activity was noticed in all the treatments and reached to lowest level at the end of studies. An increase in enzyme activity with advancement of storage period might be attributed to increased availability of substrates through hydrolysis of starch into sugars and the decrease at later stage of storage could be attributed to the reduced substrate level due to decomposition. A similar decrease in PME activity at later stages of storage was also reported by Jawandha *et al.* (3) in *ber* fruits. From the present investigation, it can be inferred that oxalic acid treatment @ 6 mmol l^{-1} is effective in extending the storage life of Nijisseiki pear fruits under low temperature storage.

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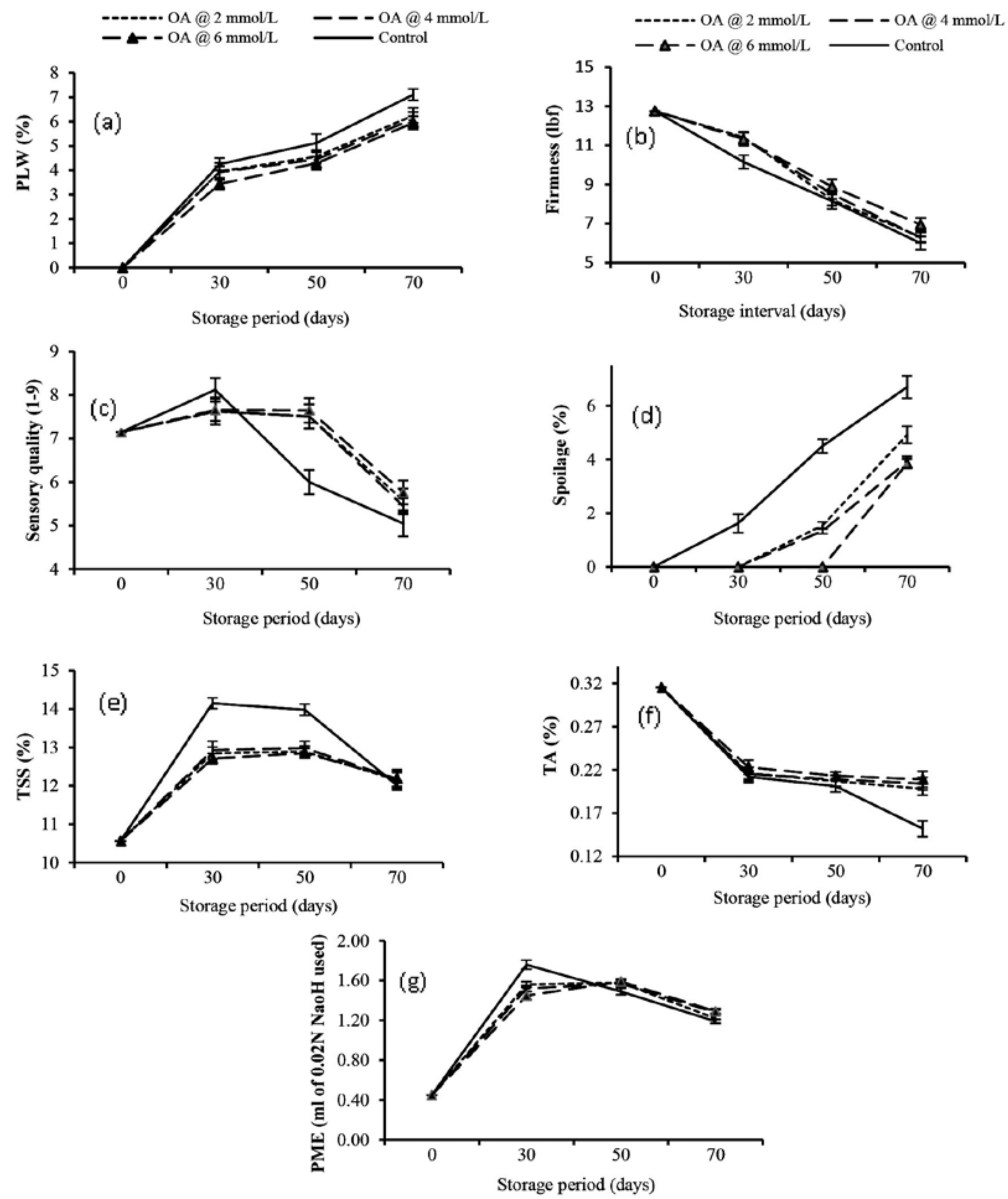

Fig. 1. Changes in PLW (a), firmness (b), sensory quality (c) spoilage (d), TSS (e), TA (f) and PME activity (g), in response to post-harvest oxalic acid treatments of pear fruits. Vertical bars represent ± SE of mean. LSD ($P \leq 0.05$) for PLW; Treatments (T) = 0.48, Storage periods (S) = 0.42, S × T = 0.84, for firmness; T = 0.53, S = 0.46, S × T = 0.93, for sensory quality; T = 0.46, S = 0.40, S × T = 0.80, for spoilage; T = 0.36, S = 0.31, S × T = 0.62, for TSS; T = 0.29, S = 0.25, S × T = 0.51, for TA; T = 0.012, S = 0.011, S × T = 0.022, for PME activity; T = 0.06, S = 0.05, S × T = 0.10

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