Effect of different storage environment on quality characteristics of tomato and kinnow fruits

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Abstract: The effect of packaging material and evaporative cooled storage environment on quality characteristics of tomato and kinnow fruits was evaluated. The experiments were carried out using complete randomized design and significant difference ($P \leq 0.05$) was observed among storage conditions and time with the observed parameters viz. plysiological loss in weight, firmness, pH, total soluble solids, acidity, ascorbic acid and overall acceptability in both summer and winter season. Packaging and evaporative cooling maintains the physico-chemical quality and shelf-life of tomato and kinnow fruits increases by more than two fold as compared to the ambient conditions. The 100 gauge LDPE (Low Density Polyethylene) bag packaging combined with evaporative cool chamber with rice husk ash (RHA) maintained the superior quality of tomato and kinnow in terms of highest overall acceptability. This novel technology is found suitable to prevent postharvest loss of horticultural produce and is recommended for short-term on farm storage.

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1 Introduction

Fresh fruits and vegetables harvested daily in glut during peak season from field are mostly stored in suitable environments until marketed or consumed. Fresh produce is more susceptible to spoilage due to continuous respiration after harvesting (Singh and Yadav, 2012a). It has also been estimated that the postharvest loss of perishable commodities is as high as 50% due to lack of packaging, transportation and storage facilities (FAO, 2005). The monetary value for the post-harvest losses of horticultural produce in India estimated about Rs. 39,300 crores/annum (Chandra and Kar, 2004). The postharvest losses could discourage farmers from producing and marketing fresh product and limit the consumption of fresh fruits and vegetables. The respiration of fresh fruits and vegetables can be reduced by many preservation techniques to control deterioration during storage (Alique et al., 2003).

The evaporatively cooled environment is suggested to be a good alternative for the small-scale peasant farmers as it require low initial and running cost compared to other cooling methods (Singh and Yadav, 2012b).The evaporative cool chambers significantly decrease the storage temperature resulting slow respiration and senescence by maintaining optimal relative humidity with reduction in water loss without accelerating decay (Awole et al., 2011). Packaging handling systems of fruits and vegetables are one of the most commonly used postharvest practice, protecting them from various transportation and storage hazards. Polyethylene packaging with micro perforation is mostly used polymer film for packaging as it offers the advantages of being inert, permeable to gases and comparatively less permeable to water vapour.

Keeping in view the present situation of energy crisis and inadequate storage facilities particularly in the under developed and developing countries like India, the present study entitled the effect of different storage

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environment on quality characteristics of tomato and kinnow fruits was undertaken to evaluate the novel evaporative cooling chamber. The combined effects of packaging and storage environment on quality and shelf-life have also been investigated.

Materials and methods

Experimental tests were conducted at Department of Processing and Food Engineering, Chaudhary Charan Singh Haryana Agricultural University, Hisar (India) located at 29°10/N latitude and 75°46/E longitudes with an altitude of 215 meters above mean sea level in semi arid region of North Western India during the year 2009-2010.

Development of evaporative cool chambers

Two evaporative cool chambers (Figure 1) of 0.37 m^3 capacity as per the design of National Horticulture Board, India were constructed with the help of baked bricks using river bed sand (RBS) and rice husk ash (RHA) to store the commodity (Anon., 1985). Two platforms of 1.65 m x 1.15 m were prepared with single layer of bricks. A double layered wall on all four sided around both the platforms was erected with the bricks leaving approximately 0.075 m space to a height of 0.675 m. River bed sand was used to fill into the gap in one whereas the other was filled by rice husk ash. Once the evaporative cool chambers were saturated with water, the river bed sand and rice husk ash were kept moist with optimum quantity of water through drip system with plastic pipes and microtubes connected to an overhead water tank. Top covers of evaporative cool chambers were prepared by gunny cloth pads with plastic sheet on one side to protect the dripping of water inside the cool chambers. Comparative performance on the basis of temperature, relative humidity and cooling efficiency of both cool chambers at no load condition was assessed for summer as well as winter season for round the year use. The data were collected throughout the day at an interval of one hour to study the temperature and relative humidity profile inside and outside of the evaporative cool chambers. The performance of both evaporative cool chambers was compared on the basis of cooling efficiency.

Thermal performance

The dry bulb temperature and relative humidity were recorded throughout the storage period using digital psychrometer units. The readings were made at one hour interval during the daytime over the study period.

Cooling efficiency (CE)

$$\text{CE (\%)} = \frac{\text{Ta - Ts}}{\text{Ta - Tw}} \times 100 \quad (1)$$

Where，Ta is dry bulb temperature of ambient air, ℃; Ts is dry bulb temperature of the cooled space air, ℃; And Tw iswet bulb temperature of ambient air, ℃.

Sample preparation

For the postharvest physico-chemical characteristics studies, tomato (summer season) and kinnow (winter season) fruits were procured from local market of Hisar,

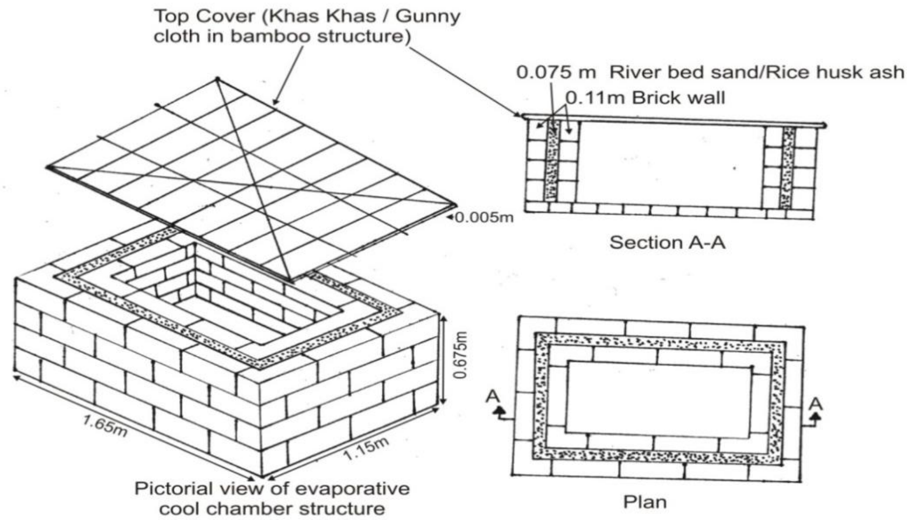

Figure 1 Structural details of evaporative cooling chamber

Haryana (India). Fruits with bruises, sign of infection or those different from the group were discarded from the samples. Uniform, unblemished tomato and kinnow fruits having similar size and color were then selected and hand washed with tap water to remove surface impurities. The fruits were surface dried with soft cloth and subdivided and stored in different storage conditions in three replications.

The storage experiment was carried out by combining tomato and kinnow fruits with three storage conditions (ECC RBS, ECC RHA and Ambient storage). For each treatment samples were taken randomly and kept under the different storage conditions using 100 gauge LDPE bags with 1% perforation. Sample from each treatment was taken for physico-chemical analysis at regular interval. All the chemicals used during the present course of investigations were of analytical grade and obtained from Himedia Laboratories Limited, Bombay and Sisco Research Laboratories Pvt. Ltd., Bombay. The nomenclatures of treatments followed were as follows:

T_1 = Ambient temperature and ambient relative humidity + 100 gauge LDPE bags with 1% perforation

T_2 = Evaporative cool chamber with river bed sand (ECC RBS) + 100 gauge LPDE bags with 1% perforation

T_3 = Evaporative cool chamber with rice husk ash (ECC RHA) + 100 gauge LDPE bags with 1% perforation

Physico-chemical constraints

Observations were recorded on physico-chemical parameters like physiological loss in weight (PLW)(%).Firmness (kg/cm^2) of samples were recorded with the help of a pressure tester of Ogawa Seiki Company Ltd., Japan make fitted with cylindrical plunger. It was measured on equatorial region of each commodity. Total soluble solids (%) of the samples were analyzed by Abbe hand refractometer. The procedure described by Ranganna (2000) was followed for determining acidity (%).Sample of five ml was titrated against 0.1N NaOH using 1-2 drop of phenolphthalein solution as indicator. The appearance of light pink colour was marked as end point. Ascorbic acid content (mg/100g) was determined by 2,6-dichlorophenol indophenol method (Ranganna, 2000), and estimated by grinding 1g of pulp with 25 ml of 3% metaphosphoric acid. The filtered extract was titrated with 5 ml aliquot against dye (2, 6-dichlorophenol indophenol dye) till light pink colour appeared at the end point. The pH of the samples was determined by digital pH meter and overall acceptability by 9-point Hedonic rating scale. All these parameters were estimated at a regular interval as per standard methods (Ranganna, 2000).

Statistical analysis

A statistical analysis was performed on triplicate data and the results were expressed as mean. The data were compared using two-way analysis of variance (ANOVA) using statistical program SPSS Version 16. Statistical differences were represented at 5% level of significance using Duncan's multiple range tests. The critical difference of treatments, storage period and interactions was calculated at $P \leq 0.05$(Singh and Yadav, 2012a).

Results and discussion

Thermal performance of the evaporative cool chambers during storage

Thermal performance of the evaporative cool chambers at no load condition is explained on the basis of average dry bulb temperature, average relative humidity and average cooling efficiency. Figure 2 shows the effect of day time on ambient and evaporative cool chambers air temperatures during storage of tomato in summer and kinnow in winter. During the storage period of tomato the ambient dry bulb air temperature varied from 31.3℃ to 38.3℃, in ECC RBS from 26.5℃ to 29.7℃ and in ECC RHA from 25.1℃ to 28.3℃, respectively (Figure 2). The average difference in dry bulb temperature between ambient and ECC RBS was 6.7℃ and between ambient and ECC RHA was 8.3℃. During storage of kinnow in evaporative cool chambers the ambient dry bulb air temperature varied from 11.4℃ to 17.1℃, in ECC RBS from 10.8℃ to 15.2℃ and in ECC RHA from 10.3℃ to 14.8℃, respectively (Figure 2). The average difference in dry bulb air temperature between ambient and ECC RBS was 1.5℃ and between ambient and ECC RHA was 2.0℃.

The evaporative cool chambers consistently recorded higher relative humidity then ambient conditions (Figure 3) during storage of tomato in summer and storage of kinnowin winter. During the storage period of tomato the relative humidity showed the variation of relative humidity from 36% to 46%, in ECC RBS 76% to 87% and in ECC RHA 84% to 95%, respectively (Figure 3). The average difference in relative humidity between ambient and ECC RBS was 42% whereas between ambient and ECC RHA was 51%. During storage of kinnow the relative humidity variation in ambient air was 67% to 81%, in ECC RBS 96% to 98% and in ECC RHA 98% to 99%, respectively. The average difference in relative humidity between ambient and ECC RBS was 22% and between ambient and ECC RHA 23%, respectively. There was little fluctuation in temperature and relative humidity in the evaporative cooler (1.8℃, 3.3%) during the storage period as compared to the wide fluctuation at ambient condition (5.2℃, 22.8%) (Figure 3).This is important and critical point for safe and effective storage of perishable commodities (Singh and Yadav, 2012b).

Figure 4 shows that the cooling efficiency of both the evaporative cool chambers during storage of tomato and kinnow fruits in summer and winter, respectively. During the storage period of tomato the cooling efficiency of ECC RBS and ECC RHA was 45% to 70% and 66% to 81%, respectively during storage of tomato. The average difference in cooling efficiency between ECC RBS and ECC RHA was 15%. During storage of kinnow the cooling efficiency during storage of kinnow of ECC RBS and ECC RHA was 24% to 68% and 44% to 86%, respectively. The average difference in the cooling efficiency between ECC RBS and ECC RHA was 15% (Figure 4). The evaporative cool chambers were effective in minimizing the extremes of temperature and RH which is in agreement with the previous reports by Workneh and Woldetsadik (2004), Tefera et al. (2007), Getenitet al. (2008). Thus, this could be a better implication for knowing the shelf-life and quality of stored produce due to its effect on reducing respiration rate, ripening and senescence.

Physico-chemical constraints

Physiological loss in weight (PLW) (%)

The PLW increased significantly during storage period for all the treatments but at a reduced rate as compared to ambient conditions during a storage period of seven days. Table 1 shows that the storage of tomato in cool chambers reduced the weight loss significantly as compared to tomatoes stored in ambient conditions. Among all the treatments T_3 tomatoes had the lowest (11.47%) weight loss. There was a progressive increase in PLW during storage of kinnow (Table 2).The rate of loss was slower during initial days, thereafter it was comparatively rapid during the storage. Maximum PLW (15.92%) was observed in T_1 storage conditions of fruits. Minimum PLW (3.58%) was noticed in T_3 storage condition on 28days of storage (Table 2). Significant difference in weight loss of tomato and kinnow fruits was observed due to the interactive effect of packaging and storage environment during most part of the storage period. The PLW differences among the treatments in this experiment appear to be due to differences in temperature and relative humidity among the storage conditions. Similar results were also presented by Nath et al., (2011) and Nunes et al., (2006). The reduced rate of respiration and transpiration could be there as on for such rate of weight loss.

Firmness (kg/cm^2)

The firmness of the any commodities is an indicator for better keeping quality. Table 1 shows that there was decrease in firmness of the tomatoes with increasing duration of storage. Table 2 revealed that the firmness of the kinnow fruits decreased gradually during the storage. The decrease was rapid and progressive in control condition but there was slower decrease in firmness stored in cool chambers in both cases. Among all the treatment T_3 was the most effective treatment. The control fruits were the least firm than the other storage conditions. Similar results were reported for mango by Workneh and Woldetsadik (2004) and Tefera et al. (2007) and for tomato by Getenit et al. (2008) and Singh et al. (2010). As the storage time progressed could be due to texture modification through degradation of polysaccharides such as pectins, cellulose and hemicellulose that take place during ripening.

pH

The effect of storage conditions on pH during storage period of tomato is presented in Table 1 and for kinnow in Table 2. There was continuous increase in pH during storage period in all the treatments. In control tomatoes, pH increased from 4.10 to 5.37. Minimum increase in pH (4.75) was observed in treatment T_3. However, the minimum (4.23) pH was observed in the kinnow fruits stored in T_3 storage condition and maximum (4.51) pH was noticed in the fruits stored in T_1 after 28 days of storage. The lower pH of fruits under ambient storage conditions could be associated with the production of acids from catabolism of sugar at faster rate under ambient condition compared to the evaporative cooler.

Total soluble solids (%)

Total soluble solids (TSS) in tomato as affected by different treatments during storage are presented in Table 1. It is clear from the data that TSS increased continuously during the period of storage in all the treatments. Maximum increase (3.43 to 4.10) in TSS was observed in control sample while minimum increase in TSS was observed in treatment T_3 (3.43 to 3.73) after sevendays of storage. These results are similar to those described by Tefera et al. (2007) for mango and Getenit et al. (2008) for tomato. This could be due to accelerated ripening because of higher temperature at ambient conditions and free access of the non packaged fruits to O_2 which increases respiration rates, resulting in faster conversion of starch to soluble sugars.

Acidity (%)

Data pertaining to acidity of tomato indicated that the acid content decreased gradually during the storage period. Among all the treatments, tomatoes treated with T_3 had the lowest rate of change of acidity. Minimum acid content was found in T_1 (0.39%). Maximum acid content was noticed in T_3 (0.50%) on 7^{th} day of storage. Results of acidity during storage in kinnow as affected by different storage are presented in Table 2. Acidity decreased gradually from 0.983% to 0.663% in control fruits (T_1) and from 0.983% to 0.819% in fruits stored in T_6. Critical perusal of the data reveals that fruits stored in cool chambers had lower acidity content than control fruits. The higher loss of acidity in control fruits could be due to depletion of organic acids as a result of relatively faster respiration and ripening rate of fruits at ambient storage. Furthermore, slow respiration as well as transpiration rate may contribute for higher retention of water in fruits.

Ascorbic acid (mg/100g)

There was progressive decrease in ascorbic acid content of tomatoes during storage in all the treatments (Table 1). There was higher retention of ascorbic acid during storage in cool chambers as compared to ambient condition. Maximum ascorbic acid (14.97 mg/100g) was recorded in T_3 while minimum was recorded in T_1 (11.43) on 7^{th} day of storage. Data pertaining to ascorbic acid content of kinnow (Table 2) reveals that ascorbic acid content decreased as the storage period increased in all the storage conditions. This trend was in agreement with the previous reports by Bron and Jacomino (2006) in which it was indicated that ascorbic acid content increased with stage of ripening and decreased once the fruit reached full ripe stage. This could be due to cell wall degradation during ripening provides substrates for ascorbic acid synthesis, explaining the ascorbic acid increase with advance in ripening.

Overall accceptability

The organoleptic quality of tomatoes decreased gradually during the storage period in all the treatments (Table 1). T_1 were unacceptable after three days of storage while T_3 treated tomatoes were acceptable even after 6^{th} day of storage. The organoleptic rating during storage of kinnow was affected in different storage conditions are presented in Table 2. Maximum score (6.17) was noticed in fruits stored in T_6 storage condition while minimum (3.23) was observed in control fruits (T_1) after 28^{th} day of storage. This might be due to thefact that in this storage condition the fruits and vegetables had slow deterioration in quality parameters. These results are in conformity with findings of Singh and Yadav (2011) in guava, Ladaniya (2007) in Nagpur Mandarin fruit and Singh et al. (2010) in tomato.

Conclusion

Storage environments and storage period with LDPE packaging had significant ($P \leq 0.05$) interaction on the quality characteristics and most of the physico-chemical parameters of tomato and kinnow fruits. PLW of stored tomato and kinnow fruits was less in evaporative cool chambers compared to the control storage conditions. Fruits with LDPE bags in the evaporative cool chamber with rice husk ash maintain the fresh weight during the storage period. As the storage time advanced, packaged fruits stored in the evaporative cool chambers had shown more total soluble solids, pH, acidity and ascorbic acid values. Perforated LDPE bags with evaporatively cooled storage with rice husk ash as cavity fill material was more effective compared to other storage conditions to maintain the quality of the stored horticultural produce.

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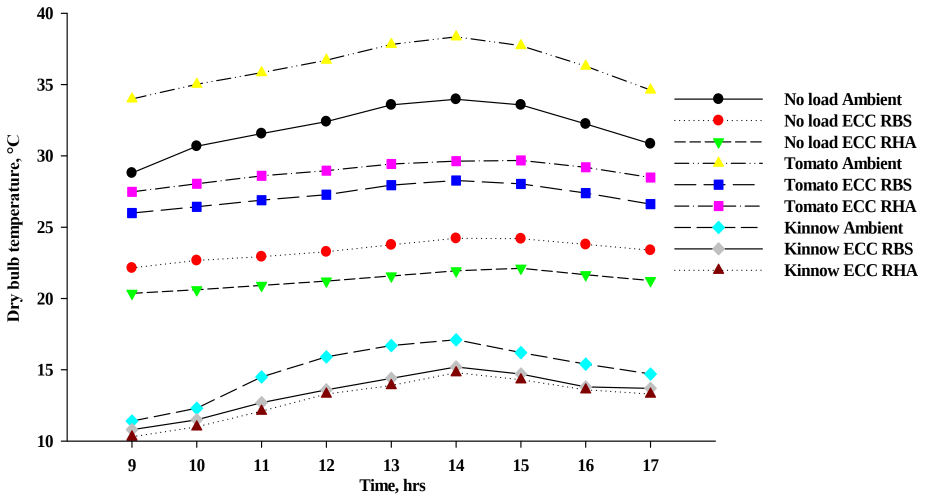

Figure 2 Effect of day time on average dry bulb temperature of ambient environment and evaporative cool chambers

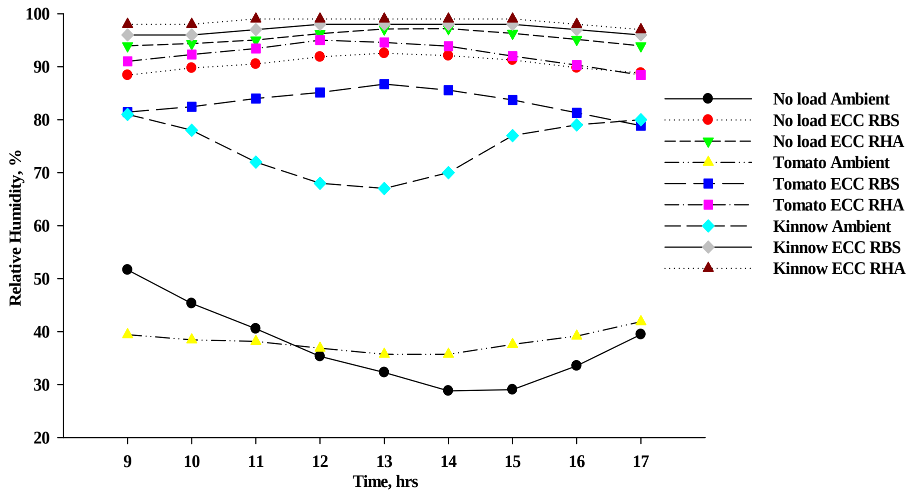

Figure 3 Effect of day time on average relative humidity of ambient environment and evaporative cool chambers

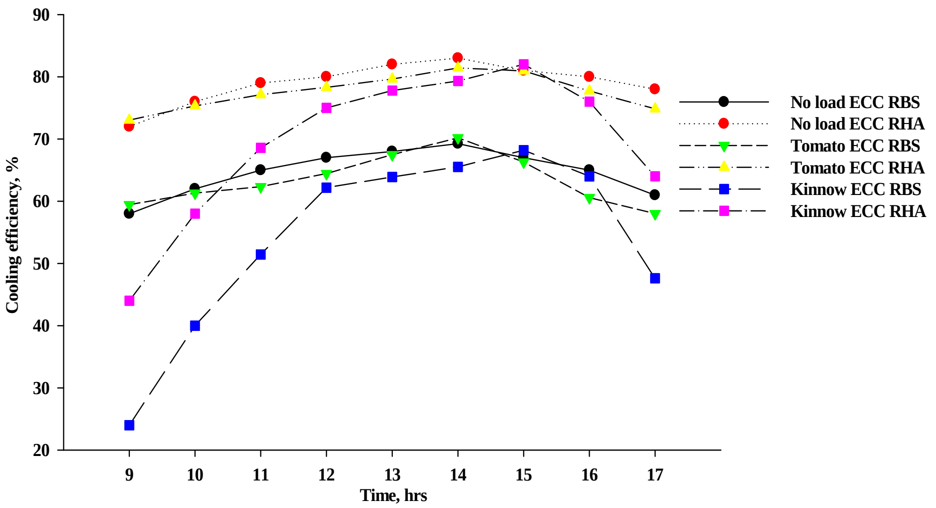

Figure 4 Effect of day time on average cooling efficiency of evaporative cool chambers

Table 1 Changes in physico-chemical parameters of tomato during different storage conditions

Treatments (T)	Storage Period (S), Days								CD at 5%
	0	1	2	3	4	5	6	7	
Physiological loss in weight, %									
T_1	0.00^{N}	1.77^{L}	4.10^{I}	7.30^{F}	11.40^{D}	12.97^{C}	14.20^{B}	16.37^{A}	T - 0.171
T_2	0.00^{N}	1.00^{M}	2.37^{K}	4.73^{H}	6.90^{FG}	8.27^{E}	11.10^{D}	14.07^{B}	S - 0.280
T_3	0.00^{N}	0.33^{N}	1.27^{M}	2.93^{J}	4.37^{HI}	6.43^{G}	8.43^{E}	11.47^{D}	S×T - 0.485
Firmness, kg/cm^2									
T_1	3.27^{A}	3.20^{ABC}	2.92^{FGH}	2.80^{H}	2.63^{I}	2.50^{I}	2.10^{J}	1.93^{K}	T - 0.052
T_2	3.27^{A}	3.20^{ABC}	3.10^{ABCDE}	3.07^{BCDEF}	3.03^{CDEF}	3.00^{DEFG}	2.87^{GH}	2.63^{I}	S - 0.085
T_3	3.27^{A}	3.23^{AB}	3.20^{ABC}	3.14^{ABCD}	3.11^{ABCDE}	3.08^{BCDEF}	3.02^{DEFG}	2.95^{EFGH}	S×T - 0.147
pH									
T_1	4.10^{H}	4.17^{H}	4.25^{GH}	4.37^{FG}	4.60^{CDE}	4.73^{CD}	5.17^{B}	5.37^{A}	T - 0.059
T_2	4.10^{H}	4.13^{H}	4.20^{GH}	4.23^{GH}	4.30^{GH}	4.53^{EF}	4.77^{C}	5.07^{B}	S - 0.097
T_3	4.10^{H}	4.13^{H}	4.17^{H}	4.20^{GH}	4.27^{GH}	4.50^{EF}	4.57^{DE}	4.75^{C}	S×T - 0.168
Total soluble solids, %									
T_1	3.43^{G}	3.47^{G}	3.50^{FG}	3.67^{CDEF}	3.70^{BCDE}	3.83^{BC}	4.03^{A}	4.10^{A}	T - 0.055
T_2	3.43^{G}	3.43^{G}	3.50^{FG}	$3.50F^{G}$	3.57^{DEFG}	3.67^{CDEF}	3.77^{BC}	3.87^{B}	S - 0.090
T_3	3.43^{G}	3.43^{G}	3.47^{G}	3.47^{G}	3.50^{FG}	3.53^{EFG}	3.67^{CDEF}	3.73^{BCD}	S×T - 0.157
Acidity, %									
T_1	0.57^{A}	0.57^{A}	0.55^{ABC}	0.52^{DEF}	0.50^{G}	0.47^{H}	0.44^{I}	0.39^{J}	T - 0.006
T_2	0.57^{A}	0.57^{A}	0.56^{AB}	0.55^{ABC}	0.54^{CDE}	0.52^{EF}	0.49^{G}	0.46^{H}	S - 0.011
T_3	0.57^{A}	0.57^{A}	0.57^{A}	0.56^{AB}	0.54^{BCD}	0.53^{CDE}	0.52^{EF}	0.50^{FG}	S×T - 0.019
Ascorbic acid, mg/100g									
T_1	19.63^{A}	19.57^{A}	19.00^{BC}	17.30^{E}	16.53^{F}	14.77^{H}	13.07^{J}	11.43^{K}	T - 0.128
T_2	19.63^{A}	19.57^{A}	19.27^{AB}	18.90^{BC}	17.90^{D}	16.83^{F}	15.47^{G}	13.97^{I}	S - 0.209
T_3	19.63^{A}	19.57^{A}	19.50^{A}	19.27^{AB}	18.83^{C}	18.07^{D}	16.73^{F}	14.97^{H}	S×T - 0.363
Overall acceptability, 9-point hedonic scale									
T_1	9.00^{A}	7.77^{C}	5.37^{G}	3.57^{J}	2.80^{K}	1.00^{M}	1.00^{M}	1.00^{M}	T - 0.083
T_2	9.00^{A}	8.13^{B}	7.47^{D}	6.13^{F}	4.90^{H}	3.97^{I}	2.50^{L}	1.00^{M}	S - 0.136
T_3	9.00^{A}	8.23^{B}	7.60^{CD}	6.77^{E}	5.37^{G}	4.80^{H}	3.77^{IJ}	3.00^{K}	S×T - 0.236

Table 2 Changes in physico-chemical parameters of kinnowduring different storage conditions

Treatments (T)	Storage Period (S), Days								CD at 5%		
	0	4	8	12	16	20	24	28			
Physiological loss in weight, %											
T_1	0.00^{P}	2.38^{KL}	4.24^{G}	6.27^{E}	8.04^{D}	10.28^{C}	12.06^{B}	15.92^{A}	T	-	0.130
T_2	0.00^{P}	0.71^{NO}	1.56^{M}	2.78^{IJ}	3.51^{H}	4.14^{G}	4.94^{F}	5.29^{F}	S	-	0.213
T_3	0.00^{P}	0.39^{OP}	1.07^{N}	1.52^{M}	2.08^{L}	2.53J^{K}	2.99^{I}	3.58^{H}	S×T	-	0.369
Firmness, kg/cm^2											
T_1	5.27^{A}	4.98^{DEF}	4.88^{GHI}	4.72^{K}	4.60^{L}	4.40^{M}	4.31^{N}	4.16^{O}	T	-	0.021
T_2	5.27^{A}	5.00^{DE}	4.93^{FGH}	4.91^{GH}	4.82^{IJ}	4.72^{K}	4.65^{L}	4.62^{L}	S	-	0.034
T_3	5.27^{A}	5.20^{B}	5.13^{C}	5.02^{D}	4.95^{EFG}	4.84^{HIJ}	4.82^{IJ}	4.81^{J}	S×T	-	0.059
pH											
T_1	3.56^{Q}	3.68^{N}	3.83^{L}	3.94^{K}	4.07^{H}	4.27^{D}	4.36^{B}	4.51^{A}	T	-	0.005
T_2	3.56^{Q}	3.61^{P}	3.63^{O}	3.82^{L}	3.97^{J}	4.02^{I}	4.21^{F}	4.31^{C}	S	-	0.009
T_3	3.56^{Q}	3.58^{Q}	3.59^{P}	3.75^{M}	3.81^{L}	3.99^{J}	4.16^{G}	4.23^{E}	S×T	-	0.016
Total soluble solids, %											
T_1	11.99^{K}	12.24^{HI}	12.40^{FG}	12.60^{E}	13.00^{B}	13.15^{A}	12.99^{B}	12.91^{B}	T	-	0.033
T_2	11.99^{K}	12.16^{IJ}	12.29^{GH}	12.39^{FG}	12.70^{CD}	12.80^{C}	12.72^{CD}	12.66^{DE}	S	-	0.054
T_3	11.99^{K}	12.09^{JK}	12.19^{IJ}	12.25^{HI}	12.31^{GH}	12.39^{FG}	12.47^{F}	12.59^{E}	S×T	-	0.093
Acidity, %											
T_1	0.98^{A}	0.94^{C}	0.89^{FG}	0.84^{I}	0.79^{L}	0.76^{M}	0.71^{N}	0.66^{O}	T	-	0.003
T_2	0.98^{A}	0.94^{BC}	0.91^{DE}	0.88^{G}	0.86^{H}	0.82^{JK}	0.79^{L}	0.76^{M}	S	-	0.006
T_3	0.98^{A}	0.95^{B}	0.91^{D}	0.90^{EF}	0.88^{G}	0.83^{J}	0.82^{JK}	0.81^{K}	S×T	-	0.011
Ascorbic acid, mg/100g											
T_1	24.80^{IJ}	25.43^{G}	25.83^{E}	26.33^{B}	26.47^{A}	24.70^{J}	23.97^{K}	23.67^{L}	T	-	0.054
T_2	24.80^{IJ}	25.23^{H}	25.60^{FG}	26.03^{D}	26.30^{B}	26.53^{A}	25.47^{G}	24.77^{J}	S	-	0.088
T_3	24.80^{IJ}	24.97^{I}	25.30^{H}	25.70^{EF}	26.00^{D}	26.20^{BC}	26.57^{A}	25.83^{E}	S×T	-	0.154
Overall acceptability, 9-point hedonic scale											
T_1	8.93^{A}	8.13^{D}	7.63^{E}	6.70^{H}	5.73^{J}	4.77^{L}	3.87^{N}	3.23^{O}	T	-	0.050
T_2	8.93^{A}	8.40^{C}	7.73^{E}	7.27^{F}	6.70^{H}	6.23^{I}	5.63^{J}	5.07^{K}	S	-	0.082
T_3	8.93^{A}	8.70^{B}	8.27^{CD}	7.87^{E}	7.40^{F}	7.10^{G}	6.77^{H}	6.17^{I}	S×T	-	0.144