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Research Article

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Effectiveness of Different Storage Conditions and Sanitizers of the Post Harvest Performance of Sweet Pepper (*Capsicum annum* L.) in Chitwan District, Nepal.

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Abstract

To investigate the effectiveness of different Storage conditions and Sanitizer treatments on the postharvest performance of the fruits of Sweet pepper var. California Wonder, an experiment was laid out in two factorial Randomized Complete Block Design (RCBD) with three replications. Fruits subjected to Sanitizer treatments viz Sodium hypochlorite @ 0.02%, Calcinated calcium @ 0.1%, Neem extract @10%, Aloe vera @10% and Control were stored under Evaporative Cooling (EC) and Ambient conditions. Observations were recorded for Physiological loss in weight (PLW), Total soluble solid (TSS), Titratable acidity (TA), Vitamin C, Spoilage percentage and Shelf life of the fruits. At the end of the shelf life, the main effects of Storage conditions and Sanitizers were found significant for PLW, Spoilage percentage, TSS, Vitamin C and Shelf life. The lowest PLW (13.19%) was observed in the fruits stored in EC condition compared to the fruits kept in Ambient storage (21.61%). EC storage showed the lowest Spoilage percentage (41.1%), the longest Shelf life (13.8 days), the highest TSS (3.16^{o}Brix) and Vitamin C (53.7 mg/100g). Among the Sanitizers, the lowest PLW (14.69%) and Spoilage percentage (37.5%) were recorded in the treatment of Sodium hypochlorite followed by Aloe vera solution. Likewise, the highest TSS (3.63^{o}Brix), Vitamin C (52.8 mg/100 g) and the longest Shelf life (13.33 days) were recorded under the treatment of Aloe vera solution. The treatment combination of EC storage and Sodium hypochlorite exhibited the lowest PLW on 9th day (11.05%) of storage. The results suggest that the postharvest quality and shelf life of sweet pepper can be extended by storing the sweet pepper fruits in energy efficient EC storage after the application of Sanitizers viz. Sodium hypochlorite and Aloe vera.

Keywords: : Evaporative cooling (EC), Postharvest performance, Sanitizers, Sweet pepper

Introduction

Sweet pepper (*Capsicum annuum* L.) commonly known as capsicum, bell pepper or green pepper belongs to family Solanaceae. Sweet pepper has low calorie value but the nutritive value is especially high for vitamins A and C. Sweet pepper is one of the world's major vegetables with a total average production of 23 mt (FAOSTAT, 2011). It is a high value crop with high market price in Nepal with heavy demands from the urban consumers. In Nepal, Sweet pepper is grown in an area of 1183.8 ha with production and productivity of 12369.3 mt and 10.4 mt/ha respectively (MoAD, 2015/16). In Chitwan, the area under Sweet pepper is 115 ha with total production of 1380 mt and productivity of 12 mt/ha (MoAD, 2015/16).

Horticulture produce are highly perishable and subjected to huge postharvest loss between 15 and 35% at different stages along the chain from harvesting to marketing (Kaini, 2000). In Nepal, the studies have reported that the postharvest losses of fruits and vegetables varied between 20-50% (Gautam and Bhattarai, 2012). Sweet pepper like other green vegetables is highly perishable and inappropriate postharvest practices lead to reduced shelf life and quality loss.

In Nepal, most growers and handlers keep their perishables at ambient conditions under which the quality of sweet pepper can be maintained only for a short time (3-4 days).The loss is further added by high decay during the storage often due to various pathogenic micro-organisms. Postharvest quality parameters are the functions of temperature and relative humidity (Jobling, 2001). Evaporative cooling (EC) storage is a simple, energy efficient and economical means of extending shelf life of produce through modulation of temperatures and humidity in an enclosure (Thomson et al., 2002).

Further, vegetables are usually treated with chlorinated water after washing to reduce the microbial load prior to packaging (Bolin et al., 1977). Alternatively, safer and eco-friendly plant based products such as neem, aloe vera, bojho etc. as sanitizer can be a sound and healthy option in place of chemicals. Thus, the aim of this study was to study the effectiveness of different storage conditions and sanitizers on the post-harvest performance of Sweet pepper.

Materials And Methods

This study was carried out during the summer season (April-May) 2017 A.D. at the laboratory of Department of Horticulture of Agricultural and Forestry University (AFU) located at Rampur, Chitwan. Sweet pepper fruits of cv. California Wonder were harvested, loaded and immediately carried to the laboratory of AFU. The experiment was conducted under the factorial Randomized Complete Block Design (RCBD). The treatment applied were storage condition viz. Evaporative cooling (EC) and ambient storage, and sanitizers (Sodium hypochlorite @ 0.02%, calcinated calcium @ 0.1%, neem extract @ 10%, aloe vera @10% and Control. EC storage of size 3 × 2 m2 was constructed at the Department of Horticulture, AFU by using bricks, gravels and sand. Double brick wall of 6 cm space was prepared and filled with gravel and sand. Gravel and sand were frequently irrigated to maintain the moisture level. Inside the EC, higher relative humidity and relatively lower temperature were maintained as a result of evaporation. In day time EC was covered with wet jute bags to lower the temperature and increase the relative humidity. The ambient storage was considered to be dry, clean, well ventilated room at normal temperature.

The treatment combinations were replicated thrice and under each treatment combination 12 fruits were kept as destructive sample for quantitative data and 10 fruits as non-destructive sample for qualitative data observation. After the preparation of sanitizer's solution, the fruits were dipped in respective treatments for 5 min followed by drying by newspaper and kept under the shade for around 30 minute. At a day interval, temperature and relative humidity of the ambient and EC storage were recorded at different time duration of a day during the entire storage period. Then after, average value for each time period of the day from 6 a.m. to 2 p.m. was calculated and plotted in the graph (figure 1).

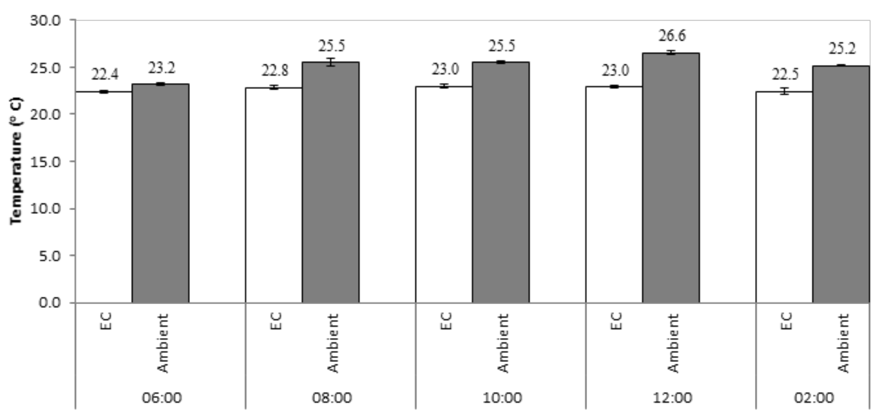


Figure 1. Average temperature (%) during the storage days inside the evaporative cooling and ambient storage in Chitwan, Nepal, 2017

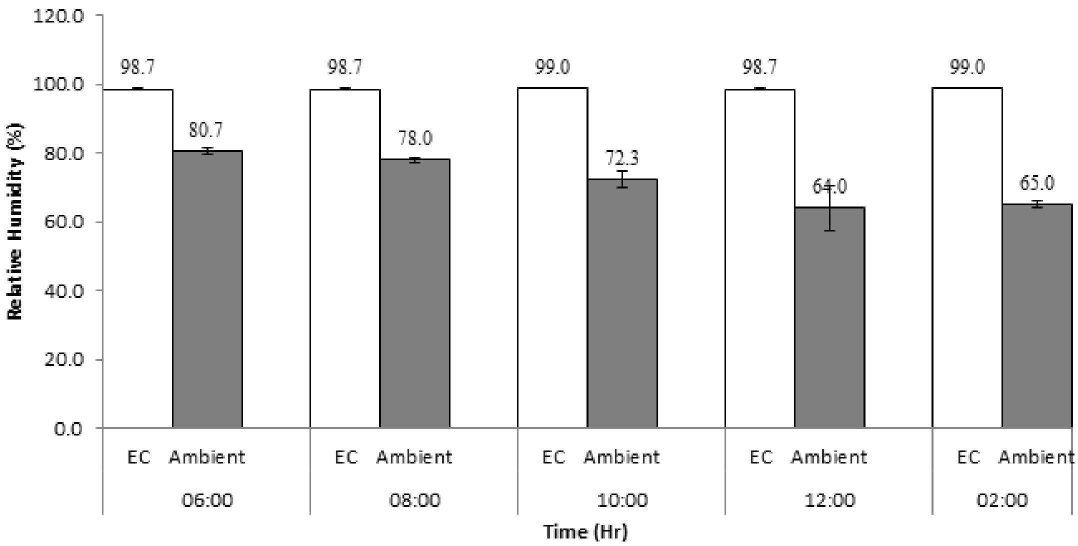


Figure 2. Average relative humidity (%) during the storage days inside the evaporative cooling and ambient storage in Chitwan, Nepal, 2017

Parameters taken for observation

Physical characters:

Color

Change in skin colour was rated on 6th day and at the end of shelf life of storage through a hedonic scale of 1 to 5 (5 - uniformly green; 4 – more green than red; 3 – equally green and red; 2 – more red than green; and 1 – uniformly red).

Physiological loss in weight (PLW)

Weight loss was recorded at 3 days interval over the storage period. A digital sensitive balance was used for the determination of fruit weight. PLW was calculated as:

$$\text{Physiological loss in weight (\%)} = [(W0 - Wt) / W0] \times 100$$

Where W0 is the initial fruits weight and Wt is the weight of the fruits at the designated time.

Spoilage percentage

The fruits of sweet pepper were visually evaluated for symptoms of decay (rots) and chilling injuries such as pitting, water soaked areas, skin blackening, etc. These were counted and expressed as Spoilage percentage.

$$\text{Spoilage percentage} = \frac{\text{Number of Decayed Fruits}}{\text{Total number of fruits}} \times 100$$

Quality Characters

Total soluble solid (0 Brix)

Total soluble solid (TSS) was determined by homogenizing sample in a blender and measured with the help of a hand held Refractometer (ERMA Inc., Tokyo, Japan).

Titratable acidity (%)

TA was measured with the help of titration method using standardized 0.1 N NaOH solution and phenolphthalein indicator (2-3 drops) and calculated as percent citric acid. Percent titratable acidity was calculated by using the formula as suggested by Saini et al., 2001.

$$\text{Titratable acidity (\%)} = \frac{\text{Volume of NaOH used (ml) x Normality of NaOH x 0.064}}{\text{Volume of juice titrated (ml)}} \times 100$$

*Acid milliequivalents (mEq) factor for citric acid

Vitamin C (Ascorbic acid) content

The ascorbic acid of the ripe fruit was measured by volumetric method as outlined by Sadasivam and Manickam (1991). The formula used to calculate the ascorbic acid content is as follow:

$$\text{Amount of ascorbic acid (mg/100g sample)} = \frac{0.5\ \text{mg} \times V2 \times 100 \times 100}{V1 \times 5\text{ml} \times \text{weight of sample}}$$

Where, V1= amount of dye consumed during the titration

V2 = amount of dye consumed when the supernatant was titrated with 4% oxalic acid

Shelf life

The fruits lots were considered to have reached the end of shelf life when 50 percent of the fruits sampled showed visual observation of shrinkage or spoilage due to pathogens and chilling injury.

Statistical Analysis

The data recorded for different parameters were subjected to analysis of variation (ANOVA) with storage conditions and different sanitizers as the sources of variation. The comparison among means was performed using the Duncan's Multiple Range Test (DMRT) at a significance level of $P < 0.05$ (Gomez, 1984).

Results And Discussion

Physiological Characters

Physiological loss in weight (PLW %)

Physiological loss in weight (PLW) of fruit as affected by both storage condition and sanitizers at storage intervals is presented in Table 1. The data showed that there was a progressive and continuous increase in PLW of fruit with the increase in days at storage. It was observed that physiological loss in weight didn't differ significantly among the treatment until 3rd day of storage (Table 1). However, effect of storage condition and sanitizer treatments on PLW were significant on 6th and 9th days of storage. On the 6th and 9th day of storage, the highest PLW% of 5.88% and 21.21% respectively were recorded under ambient storage condition. PLW% of sweet pepper stored in evaporative cooler (EC) was found to be the least (2.66%) on 6th day and 9th day of storage (13.19%). Among the sanitizer's treatments, the highest PLW of 6.32% and 20.87% on 6th and 9th day of storage respectively were recorded in Control. The fruits treated with Sodium hypochlorite showed the least PLW of 3.23% on 6th day and 14.69% on 9th day of storage. PLW of fruits treated with Aloe vera solution was statistically at par (3.40%) with Sodium hypochlorite treatment on 6th day and statistically similar (15.36%) with Sodium hypochlorite treatment on 9th day of storage (Table 4). Sweet peppers stored under ambient conditions showed a significantly higher percentage of weight losses compared to those stored under EC condition (Bayogan et al., 2017). The weight loss of Sweet peppers stored under ambient conditions had an excessive amount of water loss leading to quality deterioration because of its very low RH and higher temperature than at EC storage. Similar observations were reported by Acedo (1997) and Acedo et al., (2009).

The effectiveness of chlorine based source in reducing the physiological loss in weight of Sweet pepper might be due to its antimicrobial property that provides a protective environment against micro-organisms (Spotts and Peter, 1980). Buntong and Weinberger (2009) found ineffective results of chorine wash on four different cultivars of tomato on weight loss.

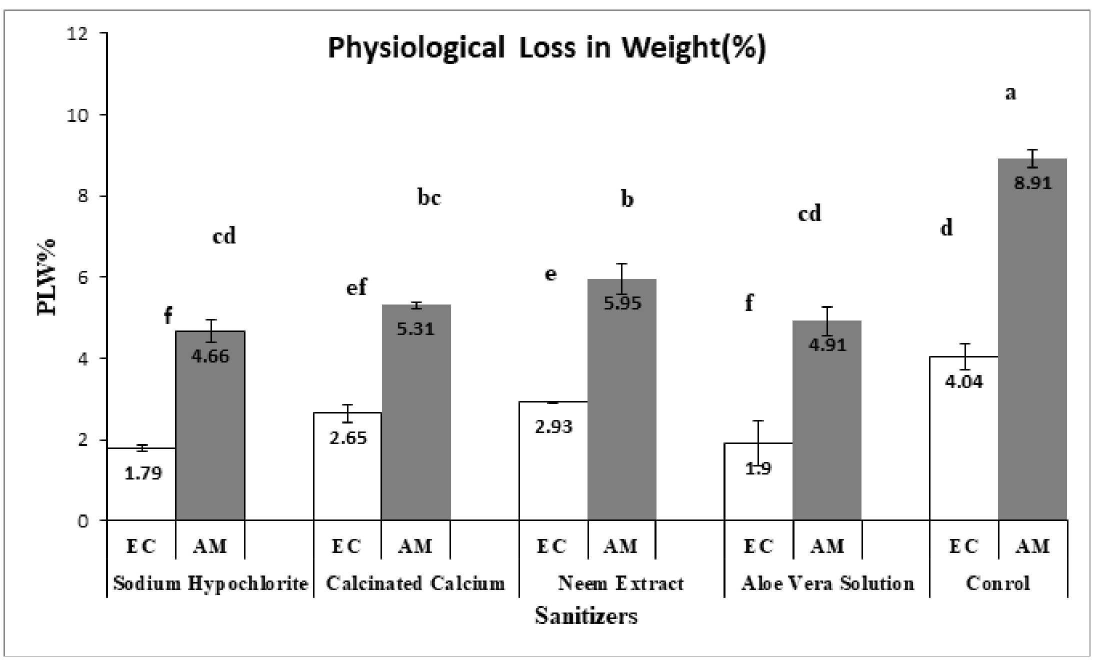
Table 1. Effect of different storage conditions and sanitizers on physiological loss in weight (PLW) of Sweet pepper at different days of storage in Chitwan, Nepal, 2017

Treatments	Physiological loss in weight (%)		
	Storage Period (Days)		
Sanitizers (A)	**Day 3**	**Day 6**	**Day 9**
Sodium hypochlorite	0.86	3.23d	14.69c
Calcinated calcium	0.99	3.98bc	18.26b
Neem extract	1.02	4.44b	17.81b
Aloe vera solution	0.95	3.40cd	15.36c
Control	1.18	6.32a	20.87a

F Test A	NS	**	**
SEM (±)	0.084	0.218	0.559
LSD	0.251	0.647	1.66
Storage condition (B)			
Evaporative cooling (EC)	0.92	2.66	13.19
Ambient	1.08	5.88	21.61
F Test B	NS	**	**
SEM (±)	0.053	0.138	0.353
LSD	0.158	0.409	1.05
Interaction			
F Test A×B	NS	*	*
CV (%)	20.7	12.5	7.9
Grand Mean	1.001	4.27	17.40
SEM (±)	0.119	0.308	0.79

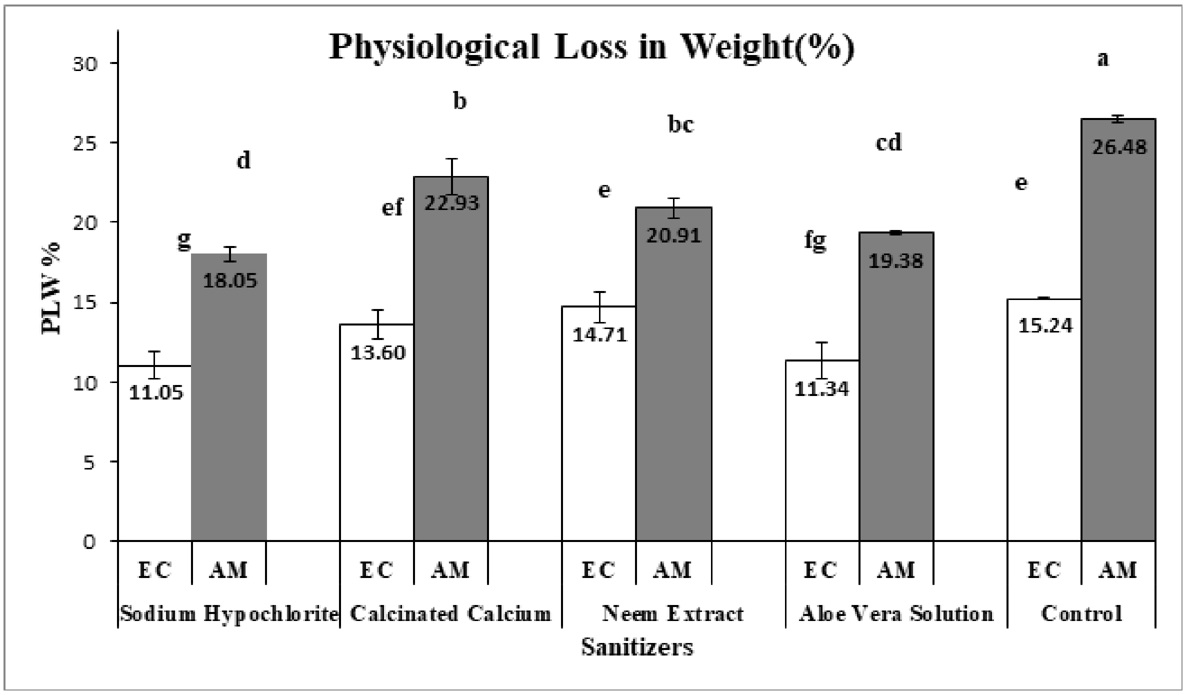
NS, * and ** indicate non-significant, significant at P<0.05, and P<0.01, respectively. Means followed by the same letter (s) in the column are not significantly different at 5% by DMRT.

The interaction effect of storage condition and sanitizers on physiological loss in weight (PLW) was found to be non-significant until 3rd day and significant on 6th and 9th days of storage. PLW of fruits under the treatment combination of evaporative cooling (EC) storage and Sodium hypochlorite was recorded to be the lowest on 6th day (1.78%) and 9th day (11.05%) of storage which was statistically at par with the treatment combination of EC and aloe vera solution on 6th day (1.89%) and 9th day (11.34%) (Figure 3). On the other hand, PLW of fruits under the treatment combination of ambient storage and untreated fruits was found to be the highest during 6th day (8.61%) and 9th day (26.49%) of storage (Figure 3 & 4). The significant results of EC storage and Sodium hypochlorite together might be due to the higher relative humidity maintained in the surrounding and application of Sodium hypochlorite as coating material. Coating materials act as a semi permeable membrane to regulate the diffusion of O2 and CO2 into and out of the fruit, thereby reducing the rate of metabolism and also prevent water loss (Smith and Staw, 1984 and Bhardwaj and Sen, 2003).



EC= Evaporative Cooling storage , AM= Ambient storage

Figure 3. Interaction effect of different storage conditions and sanitizers on physiological loss in weight (PLW) of Sweet pepper on 6th days of storage in Chitwan, Nepal, 2017



EC= Evaporative Cooling storage , AM= Ambient storage

Figure 4. Interaction effect of different storage conditions and sanitizers on physiological loss in weight (PLW) of Sweet pepper on 9th days of storage in Chitwan, Nepal, 2017.

Biochemical Characteritics

Total soluble solids

Total soluble solids (TSS) of Sweet pepper fruits as affected by both storage condition and sanitizers at storage intervals is presented in Table 2. The data show that the mean TSS content from the initial value (2.18) increased up to the 6th day (4.11^{oB}) of storage followed by decrement at the end of the storage life (3.01oB) (Table 2).

Total soluble solids (TSS) content of Sweet pepper fruits differed significantly with storage condition and sanitizers until 6rd day of storage. However, at the end of shelf life, the effect was significant for storage condition and highly significant for sanitizer's treatments. The highest TSS was recorded in evaporative cooling (EC) as compared to ambient storage. TSS content was recorded 4.31^{oB} on 6th day and 3.16^{oB} at the end of shelf life. On the other hand, TSS of fruits under ambient storage was found to be 3.91^{oB} and 2.85^{oB} on 6th and at the end of shelf life respectively. EC storage has capabilities to maintain lower temperature and higher relative humidity that result in lower respiration and transpiration rate. Stored metabolites such as sugars generally get depleted during the postharvest period as they are utilized during respiration. Sandooja et al., 1987 reported least deterioration in quality parameters of tomato such as TSS, acidity and ascorbic acid content when stored in zero energy cool chamber.

Among the sanitizer treatments, the highest TSS content was recorded in fruits treated with Aloe vera solution on both 6th day (4.45^{o}B) and at the end of shelf life (3.63^{o}B). Similarly, the lowest TSS content was recorded in untreated fruits on both 6th day (3.58^{o}B) and at end of shelf life (2.42^{o}B). On the 6th day of storage, TSS content of fruits treated with neem extract (4.35^{o}B) and Sodium hypochlorite (4.25^{o}B) were statistically similar with aloe vera solution. Likewise, fruit treated with calcinated calcium (3.90^{o}B) was statistically at par with aloe vera solution (Table 2). The retention of higher TSS and sugar contents in coated fruits can be ascribed to the lower rate of metabolic changes due to reduced respiration, which might have resulted in the retention of higher levels of metabolites. Slowing down of changes in TSS as a result of coating treatments with aloe vera gel have also been reported by various workers (Ochoa-Reyes et al., 2013; and Bhardwaj and Sen, 2003).

The interaction effect was non-significant ($P<0.05$) on TSS content during the entire period of storage.

Table 2. Effect of different storage conditions and sanitizers on total soluble solids (TSS) of Sweet pepper on different days of storage in Chitwan, Nepal, 2017

Treatments	Total soluble solids (o Brix)		
	Storage Period (Days)		
Sanitizers (A)	Initial	Day 6	End of Shelf Life
Sodium hypochlorite		4.25a	3.07b
Calcinated calcium		3.90ab	3.02b
Neem extract		4.35a	2.90b
Aloe vera solution	2.18	4.45a	3.63a
Control		3.58b	2.42c
F Test A		*	**
SEM (±)		0.19	0.124
LSD		0.58	0.37
Storage condition (B) :			
Evaporative cooling (EC)		4.31	3.16
Ambient	2.18	3.91	2.85
F Test B		*	*
SEM (±)		0.12	0.07
LSD		0.37	0.23
Interaction			
F Test A×B		NS	NS
CV(%)		11.8	10.1
Grand Mean		4.11	3.01
SEM (±)		0.28	0.17

NS, * and ** indicate non-significant and significant at P<0.05, and P<0.01, respectively. Means followed by the same letter (s) in the column are not significantly different at 5% by DMRT.

Titratable acidity (TA)

Titratable acidity (TA) of Sweet pepper fruits as affected by various post harvest treatments (storage conditions and sanitizers) is presented in table 3. The trend of data show that TA increased until the 6th day of storage followed by decrement at the end of the shelf life (Table 3). In relation to different sanitizers, Sweet pepper fruits didn't differ significantly among the treatments during the entire post harvest life. The storage conditions were also ineffective to show significant difference in Titratable acidity. Fruits stored at ambient condition showed faster decline in TA of sweet peppers as compared to the evaporative cooler storage. The interaction effect was also found to be non-significant on TA during the storage life of Sweet pepper.

Table 2. Effect of different storage conditions and sanitizers on total soluble solids (TSS) of Sweet pepper on different days of storage in Chitwan, Nepal, 2017

Treatments	Total soluble solids (o Brix)		
	Storage Period (Days)		
Sanitizers (A)	Initial	Day 6	End of Shelf Life
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Calcinated calcium		3.90ab	3.02b
Neem extract		4.35a	2.90b
Aloe vera solution	2.18	4.45a	3.63a
Control		3.58b	2.42c
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SEM (±)		0.19	0.124

LSD		0.58	0.37
Storage condition (B) :			
Evaporative cooling (EC)		4.31	3.16
Ambient	2.18	3.91	2.85
F Test B		*	*
SEM (±)		0.12	0.07
LSD		0.37	0.23
Interaction			
F Test A×B		NS	NS
CV(%)		11.8	10.1
Grand Mean		4.11	3.01
SEM (±)		0.28	0.17

NS, * and ** indicate non-significant and significant at P<0.05, and P<0.01, respectively. Means followed by the same letter (s) in the column are not significantly different at 5% by DMRT.

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Table 3. Effect of different storage conditions and sanitizers on titratable acidity (TA) of Sweet pepper at different days of storage in Chitwan, Nepal, 2017

Treatments	**Titratable Acidity (%)**		
	Storage Period (Days)		
Sanitizers (A)	**Initial**	**Day 6**	**End of Shelf Life**
Sodium hypochlorite		0.08	0.07
Calcinated calcium		0.09	0.07
Neem extract		0.09	0.07
Aloe vera solution	0.06	0.09	0.08
Control		0.10	0.07
F Test A		NS	NS
SEM (±)		0.004	0.006
LSD		0.018	0.018
Storage condition (B)			
Evaporative cooling (EC)		0.09	0.07
Ambient	0.06	0.09	0.07
F Test B		NS	NS
SEM (±)		0.006	0.004
LSD		0.012	0.011
Interaction			
F Test A×B		NS	NS
CV(%)		17	20.7
Grand Mean		0.09	0.07
SEM (±)		0.009	0.025

NS, * and ** indicate non-significant and significant at P<0.05, and P<0.01, respectively. Means followed by the same letter (s) in the column are not significantly different at 5% by DMRT.

Vitamin C (Ascorbic Acid)

Vitamin C content of Sweet pepper as affected by storage conditions and sanitizers at periodic intervals is presented in table 4. The analysis of data reveals that there is a gradual declining trend in vitamin C of fruits with the advancement in storage period under all the treatments. The initial mean value of Vitamin C (85.24 mg/100g) of Sweet pepper decreased to 72.6 mg/100g on 6th day and 42.03 mg/100g at the end of the shelf life (Table 4).

The highest vitamin C content was observed under evaporative cooling (EC) storage as compared to ambient storage. Data show that on 6th day and at the end of shelf life, vitamin C content in evaporative cooler (EC) storage were recorded 77.3 mg/100g and 53.7 mg/100g respectively. But in ambient storage it was recorded 67.8 mg/100g and 44 mg/100g on 6th and at the end of storage life, respectively (Table 4). The higher retention of vitamin C content in EC storage might be due to lower weight loss under the EC storage than ambient storage. Sandooja et al., 1987 also found quality parameters such as vitamin C content of tomato better when stored in evaporative cooling storage. Wasker (1999) too reported that change in physio-chemical constituents was slow in fruits when kept in EC.

Among the sanitizer treatments, the highest vitamin C content was recorded in fruits treated with aloe vera solutions on both 6th day (76.6 mg/100 g) and at the end of shelf life (52.8 mg/100g). The lowest vitamin C content was recorded in untreated fruits both on 6th day (63.9 mg/100g) and at the end of shelf life (40.1 mg/100g). At both storage interval, fruits treated with calcinated calcium, neem extract and sodium hypochlorite were statistically similar with aloe vera solutions in respect of vitamin C contents (Table 4). Lower ascorbic acid content in the control fruit might have been due to the faster ripening and senescence changes in such fruits which could have destroyed the ascorbic acid whereas other treatment which delays the senescence process could retain higher ascorbic acid. Similar slowing down of changes in ascorbic acid contents as a result of sanitizers and coating treatments have also been reported in case of longan fruit (Jiang and Li, 2001) and strawberry (Amal et al., 2010)

The interaction effect of different storage conditions and sanitizers for vitamin C content was found to be non-significant at different storage intervals.

Table 4. Effect of different storage conditions and sanitizers on vitamin C content of Sweet pepper at different days of storage in Chitwan, Nepal, 2017

Treatments	Vitamin C (mg/100g)		
	Storage Period (Days)		
Sanitizers (A)	Initial	Day 6	End of Shelf Life
Sanitizers (A)		73.0a	49.2a
Sodium hypochlorite		75.8a	52.0a
Calcinated calcium		73.5a	50.0a
Neem extract	0.06	76.6a	52.8a
Aloe vera solution		63.9b	40.1b
Control		*	*
F Test A		2.86	2.85
SEM (±)		8.5	8.47
LSD			
Storage condition (B):		77.3	53.7
Evaporative cooling (EC)	0.06	67.8	44.0
Ambient		*	*
F Test B		1.81	1.80
SEM (±)		5.37	5.36
LSD			
Interaction			
F Test A×B		NS	NS
CV(%)		9.7	14.3
Grand Mean		72.6	48.8
SEM (±)		0.075	4.03

NS, * and ** indicate non-significant and significant at P<0.05, and P<0.01, respectively. Means followed by the same letter (s) in the column are not significantly different at 5% by DMRT.

Shelf Life

The data on shelf life of Sweet pepper fruits as affected by storage conditions and sanitizers is presented in table 5. It is evident from the data that storage conditions had highly significant (P<0.01) effect on the shelf life. Maximum shelf life (13.8 days) was observed for fruits stored under the EC storage and minimum shelf life (10.27 days) was observed under ambient storage (Table 5).The results were in consistent with the results of Bayogan et al., (2017) whom observed the storage life of Sweet peppers stored under evaporative cooler as 16 days while those stored in the ambient condition was only 8 days. The longer shelf life under EC storage might be due to reduced weight loss, better maintained total soluble solids and titratable acidity in the fruits of Sweet peppers.

Similarly, sanitizer treatments had highly significant effect on shelf life of fruits. The maximum (13.33 days) shelf life was observed in the fruits treated with aloe vera solution and minimum (10 days) in the control (Table 5). The shelf life of fruits treated with neem extract (12.83 days) were at par with the fruit treated with aloe vera solution (13.33) followed by calcinated calcium (12 days) and Sodium hypochlorite (12 days). This might be due to creation of partial obstruction to the movement of moisture across the surface of fruits, thus reducing moisture loss during postharvest storage period. Aloe vera has shown desirable quality attributes on produce with good barrier character, without residual odour or taste flavour and efficient antimicrobial activity (Dhall, 2013).

The interaction of storage conditions with sanitizer treatments had non-significant effect on the shelf life of Sweet pepper fruits.

Table 5. Effect of different storage conditions and sanitizers on shelf life of Sweet pepper at the end of shelf life in Chitwan, Nepal, 2017

Treatments	**At the end of shelf life**
Sanitizers (A)	**Shelf Life (Days)**
Sodium hypochlorite	12.0b
Calcinated Calcium	12.0b
Neem Extract	12.83ab
Aloe vera solution	13.33a
Control	10.0c
F Test A	**
SEM (±)	0.414
LSD	1.23
Storage condition (B)	
Evaporative cooling (EC)	13.80
Ambient	10.27
F Test B	**
SEM (±)	0.262
LSD	0.77
Interaction	
F Test A×B	NS
CV(%)	8.4
Grand Mean	12.03
SEM (±)	0.585

NS, * and ** indicate non-significant and significant at P<0.05, and P<0.01, respectively. Means followed by the same letter (s) in the column are not significantly different at 5% by DMRT.

Conclusion

Evaporative cooling storage (EC) was found to be better alternative to ambient storage. The lowest PLW and Spoilage percentage, longest shelf life and highest TSS and Vitamin C were observed under the EC storage conditions. Similarly, the sanitizers viz. aloe vera solution and sodium hypochlorite as main effect and in combination with EC storage were found effective to obtain least PLW and spoilage percentage, highest TSS, vitamin C and the longest shelf life of sweet pepper fruits. Thus, post harvest quality and shelf life of sweet pepper can be extended by using energy efficient evaporative cooling (EC) storage and application of sanitizers viz. Aloe vera solution and Sodium chlorite.

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