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EFFECT OF CALCIUM AND MODIFIED CONDITION ON THE POST HARVEST QUALITY OF TOMATO (*LYCOPERSICON ESCULENTUM*)

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ABSTRACT

Major losses in tomato quality and quantity occur between harvest and consumption. Keeping this in view, the present study was conducted to study the effect of calcium chloride, packaging and storage conditions on quality and shelf life of tomato. The physico-chemical characteristics and shelf life of tomato fruits (cv. himsona) treated with calcium chloride (0.5, 1.0 and 1.5 per cent) along with different packaging materials were studied under ambient and refrigerated conditions. Among the tested treatments a significant delay in the change of weight loss (5.16%), rotting percentage (5.59%) and lycopene accumulation (3.38%) was exhibited by fruits treated with 1.5 per cent calcium chloride, packed in LDPE bags (20 μ thickness) and stored under refrigerated conditions whereas, in ambient conditions the weight loss was 9.20 %, decay per cent was 12.82 and lycopene accumulation was 3.45 %.The shelf life of tomato under this condition extended upto 33 days as compared to non- treated ones (10 days).Hence, it could be concluded that post harvest chemical treatment with calcium chloride (1.5%) has the potential to control decaying incidence, prolong the storage life and preserve valuable attributes of the tomato fruit.

INTRODUCTION

Tomato (*Lycopersicon esculentum* Mill) is one of the most important vegetable crops cultivated all over the world for its fleshy fruits. It is considered as protective as well as productive food because of its special nutritive value and also wide spread production. Tomato is a major contributor of carotenoids (especially lycopene), phenolics, vitamin C and small amounts of vitamin E in daily diets (Khachick *et al.*, 2002). Since tomato is highly perishable it encounters several problems in its transportation, storage and marketing (Pila *et al.*, 2010). Owing to lack of information about appropriate post harvest treatments, packaging, temperature etc. the fruits not only lose their quality but also encounter a substantial post harvest loss. Hence, to extend the storage life of tomatoes, regulation of ripening by retarding the metabolic activities coupled with prevention of microbial attack is an important consideration. In the past, some efforts have been made in this direction by employing certain chemicals/ plant growth hormones to hasten or delay ripening, to reduce losses and to improve and maintain the colour and quality by slowing down the metabolic activities of the fruit. These chemicals are reported to arrest the growth and spread of microorganisms by reducing the shriveling which ultimately leads to an increased shelf life and maintain the marketability of the fruits for a longer period (Sudha *et al.*, 2007).

Calcium ions are known to be involved in many physiological processes in fruits and vegetables, playing an important role in maintaining their quality. Increased Ca^{+2} levels have been shown to reduce respiration and ethylene production rates in a variety of fruit crops including tomato (Garcia *et al.*, 1995). Effectiveness of the method of $CaCl_2$ applications as a postharvest treatment differs among crops (Shorter and Joyce, 1998).

Packaging on the other hand, can create modified gas atmospheres around the product which slows down the respiratory activity of tomato. Sealing of tomatoes in polyethylene film packages extended the length of time until ripening. Weight loss in wrapped tomato was significantly decreased and fruits were more firm than wrapped tomatoes (Shahnawaz *et al.*, 2012). The present investigation was therefore, undertaken to evaluate the potential of post harvest treatments of calcium chloride, different packaging materials and temperature on the shelf life and quality characteristics of tomato fruit during storage.

MATERIALS AND METHODS

For the present study Himsona, a commercial cultivar was harvested from the farmer's field. Well developed, uniform sized and injury free fruits at breaker stage were brought to the laboratory. Damaged and infected fruits were selected for imposing treatments. After removing the dust from the surface of fruits, they were surface sterilized with sodium hypochlorite (200ppm) for 10 minutes so as to reduce the fungal infection and air dried. The post harvest treatments were: T_1 ($CaCl_2$

Table 1: Effect of packaging and post harvest chemical treatments on Physiological Loss in Weight (%) of tomato fruit during ambient and refrigerated storage

Treatment	Ambient Storage period (days)				Mean	Refrigerated Storage period (days)				Mean
	7	14	21	28		7	14	21	28	
T_1 ($CaCl_2$ 0.5% + LDPE bags)	5.71	8.00	10.61	13.46	9.44	1.76	5.81	8.38	9.89	6.46
T_2 ($CaCl_2$ 1.0 % + LDPE bags)	5.43	7.57	9.53	11.11	8.41	1.61	5.00	7.10	9.15	5.71
T_3 ($CaCl_2$ 1.5% + LDPE bags)	4.68	6.14	7.41	9.20	6.86	1.43	3.71	6.64	8.86	5.16
T_4 (Non treated + LDPE bags)	5.96	8.44	12.61	15.25	10.56	1.89	6.65	9.72	10.87	7.28
T_5 ($CaCl_2$ 0.5 % + Gunny bags)	6.10	10.87	13.30	19.41	12.42	3.25	9.41	12.33	15.20	10.05
T_6 ($CaCl_2$ 1.0% + Gunny bags)	5.88	10.15	12.47	19.15	11.91	3.00	8.95	11.14	13.89	9.24
T_7 ($CaCl_2$ 1.5% + Gunny bags)	5.47	9.88	11.33	17.78	11.11	2.85	7.42	9.97	10.31	7.64
T_8 (Non treated+ Gunny bags)	7.30	14.46	19.37	22.89	16.00	5.38	10.70	14.81	17.47	12.09
T_9 (Control)	8.70	17.78	21.78	26.12	18.59	7.50	13.85	19.41	21.75	15.63
Mean	6.14	10.37	13.16	17.15		3.19	7.94	11.06	13.04	

Initial value		
CD (0.05)	Ambient storage	Refrigerated storage
Storage	0.049	0.027
Treatment	0.073	0.041
Storage x treatment	0.147	0.081

Table 2: Effect of packaging and post harvest chemical treatments on decay (%) of tomato fruit during ambient and refrigerated storage

Treatment	Ambient storage Storage period (days)				Mean	Refrigerated storage Storage period (days)				Mean
	7	14	21	28		7	14	21	28	
T_1 ($CaCl_2$ 0.5% + LDPE bags)	-	6.59	12.17	19.75	9.63	-	3.14	9.99	13.38	6.63
T_2 ($CaCl_2$ 1.0 % + LDPE bags)	-	6.21	11.14	17.46	8.70	-	2.93	9.25	12.57	6.19
T_3 ($CaCl_2$ 1.5% + LDPE bags)	-	5.63	9.31	12.82	6.94	-	2.61	8.86	10.91	5.59
T_4 (Non treated + LDPE bags)	-	8.89	14.86	20.16	10.97	-	5.71	11.46	17.00	8.54
T_5 ($CaCl_2$ 0.5 % + Gunny bags)	-	9.75	18.81	28.16	14.18	-	7.21	12.62	23.11	10.73
T_6 ($CaCl_2$ 1.0% + Gunny bags)	-	8.43	15.36	23.14	11.73	-	6.82	11.45	20.26	9.63
T_7 ($CaCl_2$ 1.5% + Gunny bags)	-	8.11	12.16	20.53	10.20	-	5.51	10.31	18.10	8.48
T_8 (Non treated+ Gunny bags)	6.51	10.21	20.24	33.32	17.57	3.45	8.82	13.21	26.47	12.99
T_9 (Control)	9.32	17.63	27.47	38.62	23.26	4.32	10.86	17.25	28.32	15.18
Mean	1.76	9.05	15.72	23.77		0.86	5.96	11.60	18.90	

Initial value		
CD (0.05)	Ambient storage	Refrigerated storage
Storage	0.029	0.039
Treatment	0.044	0.058
Storage x treatment	0.088	0.117

0.5%), T_2 ($CaCl_2$ 1.0%), T_3 ($CaCl_2$ 1.5%), T_4 (Non-treated) and packed in LDPE bags (20µ thickness), T_5 ($CaCl_2$ 0.5%), T_6 ($CaCl_2$ 1.0 %), T_7 ($CaCl_2$ 1.5%), T_8 (Non-treated) packed in gunny bags and T_9 (control). Each of these treatments were given by dipping the fruits of each set comprising of 10 fruits in the treatment solution for 20 min. The treated tomato fruits were then stored under ambient (34±2°C) and refrigerated conditions. The stored fruits were then analyzed at regular interval of 7, 14, 21 and 28 days for various physicochemical parameters. The PLW of tomato fruit samples was calculated by considering the differences between initial weight and final weight of tested fruits divided by their initial weight. The decay or rotting of the stored tomato fruits were determined by their visual observations. The shelf life of tomato was calculated by counting the days required for them to attain the last stage of ripening, but up to the stage when they remained still acceptable for marketing (Moneruzzaman *et al.*, 2009).TSS was determined by using refractometer, acidity by treating against sodium hydroxide solution, ascorbic acid by 2, 6-Dichlorophenol- Indophenol visual titration methodRangana (1995). Reducing sugars and total sugars were determined by Lane and Eynon method as described by Rangana (1995). Lycopene was performed according to the method of AOAC (1995). All the analysis was carried out in triplicate. The experimental design was complete randomized design. ANOVA was used to detect treatment effect.

RESULTS AND DISCUSSION

Weight loss of fresh tomatoes is primarily due to transpiration and respiration. The data on physiological loss in weight (PLW) as influenced by post harvest treatments and storage conditions is presented in Table 1. It is evident from the table that weight loss percentage increased significantly as the storage proceeds. In general the PLW was less under refrigerated conditions as compared to ambient conditions in all the

Table 3: Effect of packaging and post harvest chemical treatments on Total Soluble Solids (%) of tomato fruit during ambient and refrigerated storage

Treatment	Ambient storage Storage period (days)				Mean	Refrigerated storage Storage period (days)				Mean
	7	14	21	28		7	14	21	28	
T_1 ($CaCl_2$ 0.5% + LDPE bags)	4.38	4.58	4.77	4.43	4.54	4.28	4.54	4.72	4.39	4.48
T_2 ($CaCl_2$ 1.0 % + LDPE bags)	4.25	4.43	4.66	4.35	4.42	4.19	4.37	4.58	4.27	4.35
T_3 ($CaCl_2$ 1.5% + LDPE bags)	4.11	4.3	4.52	4.44	4.34	4.00	4.21	4.49	4.18	4.22
T_4 (Non treated + LDPE bags)	4.43	4.71	4.85	4.63	4.65	4.37	4.62	4.8	4.58	4.59
T_5 ($CaCl_2$ 0.5 % + Gunny bags)	4.71	4.89	5.00	4.72	4.83	4.64	4.81	4.9	4.67	4.75
T_6 ($CaCl_2$ 1.0% + Gunny bags)	4.67	4.77	4.91	4.65	4.75	4.58	4.73	4.88	4.55	4.69
T_7 ($CaCl_2$ 1.5% + Gunny bags)	4.54	4.7	4.83	4.5	4.64	4.46	4.65	4.77	4.47	4.59
T_8 (Non treated+ Gunny bags)	4.83	5.06	5.21	5.00	5.02	4.78	4.96	5.10	4.78	4.91
T_9 (Control)	5.15	5.3	5.42	5.33	5.30	5.08	5.27	5.46	5.30	5.27
Mean	4.56	4.75	4.91	4.67		4.49	4.68	4.86	4.58	

Initial value	3.90	
CD (0.05)	Ambient storage	Refrigerated storage
Storage	0.049	0.043
Treatment	0.073	0.065
Storage x treatment	NS	NS

Table 4: Effect of packaging and post harvest chemical treatments on Titratable acidity (%) of tomato fruit during ambient and refrigerated storage

Treatment	Ambient storage Storage period (days)				Mean	Refrigerated storage Storage period (days)				Mean
	7	14	21	28		7	14	21	28	
T_1 ($CaCl_2$ 0.5% + LDPE bags)	0.64	0.47	0.38	0.33	0.45	0.61	0.47	0.38	0.30	0.44
T_2 ($CaCl_2$ 1.0 % + LDPE bags)	0.67	0.51	0.40	0.35	0.48	0.63	0.50	0.42	0.36	0.48
T_3 ($CaCl_2$ 1.5% + LDPE bags)	0.69	0.55	0.48	0.39	0.52	0.66	0.59	0.50	0.45	0.55
T_4 (Non treated + LDPE bags)	0.61	0.44	0.36	0.31	0.43	0.57	0.45	0.35	0.27	0.41
T_5 ($CaCl_2$ 0.5 % + Gunny bags)	0.47	0.31	0.25	0.23	0.31	0.44	0.36	0.26	0.20	0.31
T_6 ($CaCl_2$ 1.0% + Gunny bags)	0.53	0.36	0.30	0.25	0.36	0.49	0.39	0.30	0.24	0.36
T_7 ($CaCl_2$ 1.5% + Gunny bags)	0.57	0.41	0.32	0.27	0.39	0.54	0.41	0.32	0.27	0.38
T_8 (Non treated+ Gunny bags)	0.43	0.35	0.28	0.21	0.32	0.40	0.33	0.22	0.18	0.28
T_9 (Control)	0.38	0.30	0.25	0.18	0.28	0.33	0.27	0.20	0.15	0.24
Mean	0.55	0.41	0.33	0.28		0.52	0.42	0.33	0.27	

Initial value	0.75	
CD (0.05)	Ambient storage	Refrigerated storage
Storage	0.043	0.038
Treatment	0.065	0.057
Storage x treatment	NS	NS

treatments. Among the post harvest treatments PLW was observed to be the lowest in fruits treated with calcium chloride and packed in LDPE bags under both refrigerated (5.16%) and ambient (6.86%) storage conditions. This could be due to temperature effects on vapour pressure difference which increased water retention (Tasdelen and Bayindirli, 1998). This also could be attributed to the maintenance of high humidity within the packages by the respiring fruits and due to low water vapour transmission rates of packaging material (Onwuzulu *et al.*, 1995). The physiological loss in weight was observed to be highest in control under both ambient and refrigerated conditions at all storage intervals.

Initially for a period of 7 days no decay was observed in all the treatments except control (Table 2) both under ambient (6.51%) and refrigerated (3.45%) conditions. The decay percentage increased with the increase in storage period and was observed to be the lowest in fruits treated with calcium chloride (1.5%) and packed in LDPE bags under both storage conditions. Significant differences were observed between all the treatments and storage period with respect to decay percentage. Singh *et al.* (1992) also observed that decay percentage of tomatoes increased with the increase in storage period.

Tomatoes treated with calcium chloride (1.5%), packed in LDPE bags and stored under refrigerated conditions (Fig. 1) had the maximum shelf life (33 days) whereas, minimum shelf life was observed in treatment T_9(Control) under ambient conditions. This could be because polyethylene bag created a modified atmosphere by increasing CO_2 and decreasing O_2. These results also supports the view of Cheour *et al.* (1991) who reported that the application of calcium prolonged the storage life of strawberries, as measured by delay in

Table 5: Effect of packaging and post harvest chemical treatments on Reducing sugar (%) of tomato fruit during ambient and refrigerated storage

Treatment	Ambient storage Storage period (days)				Mean	Refrigerated Storage Storage period (days)				Mean
	7	14	21	28		7	14	21	28	
T_1 ($CaCl_2$ 0.5% + LDPE bags)	2.31	2.37	2.47	2.59	2.43	2.28	2.34	2.41	2.52	2.39
T_2 ($CaCl_2$ 1.0 % + LDPE bags)	2.27	2.34	2.40	2.52	2.38	2.23	2.3	2.36	2.49	2.34
T_3 ($CaCl_2$ 1.5% + LDPE bags)	2.22	2.31	2.38	2.48	2.35	2.20	2.30	2.34	2.40	2.31
T_4 (Non treated + LDPE bags)	2.34	2.40	2.52	2.67	2.48	2.31	2.36	2.49	2.61	2.44
T_5 ($CaCl_2$ 0.5 % + Gunny bags)	2.37	2.58	3.77	3.80	3.13	2.33	2.53	3.72	3.77	3.09
T_6 ($CaCl_2$ 1.0% + Gunny bags)	2.32	2.47	3.61	3.74	3.03	2.30	2.42	3.57	3.69	2.99
T_7 ($CaCl_2$ 1.5% + Gunny bags)	2.30	2.42	3.55	3.71	2.99	2.27	2.39	3.47	3.66	2.95
T_8 (Non treated+ Gunny bags)	2.41	3.63	3.84	3.96	3.46	2.39	2.57	3.76	3.85	3.14
T_9 (Control)	2.47	3.78	3.85	3.50	3.40	2.43	2.67	3.98	3.45	2.94
Mean	2.33	2.70	3.15	3.22		2.30	2.43	3.12	3.16	

Initial value	2.10	
CD (0.05)	Ambient storage	Refrigerated storage
Storage	0.033	0.033
Treatment	0.048	0.048
Storage x treatment	0.098	0.098

Table 6: Effect of packaging and post harvest chemical treatments on Total sugars content (%) of tomato fruit during ambient and refrigerated storage

Treatment	Ambient storage Storage period (days)				Mean	Refrigerated storage Storage period (days)				Mean
	7	14	21	28		7	14	21	28	
T_1 ($CaCl_2$ 0.5% + LDPE bags)	4.15	4.23	4.32	4.44	4.28	4.09	4.16	4.21	4.29	4.19
T_2 ($CaCl_2$ 1.0 % + LDPE bags)	4.00	4.17	4.21	4.37	4.19	3.9	3.97	4.11	4.19	4.04
T_3 ($CaCl_2$ 1.5% + LDPE bags)	3.88	3.92	4.10	4.17	4.02	3.75	3.82	3.94	4.1	3.90
T_4 (Non treated + LDPE bags)	4.29	4.35	4.43	4.56	4.41	4.2	4.28	4.34	4.4	4.31
T_5 ($CaCl_2$ 0.5 % + Gunny bags)	4.53	4.65	4.70	4.78	4.66	4.48	4.54	4.61	4.69	4.58
T_6 ($CaCl_2$ 1.0% + Gunny bags)	4.41	4.54	4.60	4.67	4.55	4.34	4.4	4.51	4.59	4.46
T_7 ($CaCl_2$ 1.5% + Gunny bags)	4.32	4.43	4.50	4.59	4.46	4.27	4.31	4.43	4.51	4.38
T_8 (Non treated+ Gunny bags)	4.61	4.73	4.82	4.88	4.76	4.52	4.61	4.75	4.79	4.67
T_9 (Control)	4.80	4.86	4.94	4.63	4.81	4.61	4.78	4.84	4.5	4.68
Mean	4.33	4.43	4.51	4.57		4.24	4.32	4.42	4.45	

Initial value	3.70	
CD (0.05)	Ambient storage	Refrigerated storage
Storage	0.043	0.043
Treatment	0.065	0.065
Storage x treatment	0.130	0.130

accumulation of sugars, decrease in organic acids and increase of colour. Sammi and Masud (2007) also reported that calcium dips retarded the metabolism as indicated by the slow ripening rate. Calcium chloride improved the firmness of the fruits.

The changes in the TSS values of treated and control tomato fruits during their post harvest storage which are presented in Table 3 showed that control sample had highest TSS value (5.42° B) after 28 days of storage period whereas, lowest TSS was observed in fruits treated with calcium chloride (1.5%), packed in LDPE bags and stored under refrigerated (4.18°B) as well as ambient (4.44° B) conditions. The TSS values of tomato fruits treated with calcium chloride were lower than that of control samples both under ambient and refrigerated conditions. The reduction in the TSS of calcium treated fruit was probably due to slowing down of respiration and metabolic activity, hence retarding the ripening process. Similar results have been reported by Reshi *et al.* (2013) in stored litchi fruits. There was significant increase in TSS during storage both under ambient and refrigerated conditions. The TSS might have increased due to degradation of polysaccharides to simple sugars thereby causing rise in TSS (Naik *et al.*, 1993)

The data on titratable acidity as influenced by post harvest treatments and storage conditions presented in Table 4 indicated that maximum acidity was observed in T_3 (0.52% and 0.55%), followed by T_2 (0.48% and 0.48%) and T_1 (0.45% and 0.44%) under ambient and refrigerated storage conditions, respectively. The titratable acidity content decreased with storage under ambient as well as refrigerated conditions. Disappearance of mailc and citric acid during ripening process may be the main factor responsible for the reduction in titratable acidity during storage (Sammi and Masud 2007). Perhaps the

Table 7: Effect of packaging and post harvest chemical treatments on Ascorbic acid content (%) of tomato fruit during ambient and refrigerated storage

Treatment	Ambient storage Storage period (days) 7	14	21	28	Mean	Refrigerated storage Storage period (days) 7	14	21	28	Mean
T_1 ($CaCl_2$ 0.5% + LDPE bags)	12.31	12.26	12.14	11.90	12.15	12.51	12.45	12.37	12.27	12.40
T_2 ($CaCl_2$ 1.0 % + LDPE bags)	12.47	12.30	12.21	12.03	12.25	12.63	12.61	12.47	12.31	12.50
T_3 ($CaCl_2$ 1.5% + LDPE bags)	12.68	12.57	12.39	12.15	12.45	12.75	12.68	12.51	12.40	12.58
T_4 (Non treated + LDPE bags)	12.15	12.00	11.87	11.64	11.91	12.46	12.39	12.31	12.14	12.32
T_5 ($CaCl_2$ 0.5 % + Gunny bags)	12.00	11.81	11.69	11.32	11.70	12.19	12.07	11.91	11.75	11.98
T_6 ($CaCl_2$ 1.0% + Gunny bags)	12.10	11.95	11.73	11.51	11.82	12.27	12.16	12.10	11.97	12.12
T_7 ($CaCl_2$ 1.5% + Gunny bags)	12.20	12.11	12.06	11.75	12.03	12.38	12.21	12.15	12.08	12.20
T_8 (Non treated+ Gunny bags)	11.74	11.31	11.10	10.85	11.25	12.10	11.94	11.81	11.77	11.90
T_9 (Control)	10.30	9.23	9.02	8.88	9.36	11.87	11.54	11.11	10.80	11.33
Mean	11.99	11.73	11.58	11.34		12.35	12.23	12.08	11.94	

Initial value	12.80	
CD (0.05)	Ambient storage	Refrigerated storage
Storage	0.048	0.038
Treatment	0.073	0.057
Storage x treatment	0.147	0.114

Table 8: Effect of packaging and post harvest chemical treatments on Lycopene content (%) of tomato fruit during ambient and refrigerated storage

Treatment	Ambient storage Storage period (days) 7	14	21	28	Mean	Refrigerated storage Storage period (days) 7	14	21	28	Mean
T_1 ($CaCl_2$ 0.5% + LDPE bags)	3.45	3.58	3.70	3.89	3.65	3.40	3.52	3.67	3.82	3.66
T_2 ($CaCl_2$ 1.0 % + LDPE bags)	3.38	3.49	3.62	3.75	3.56	3.31	3.39	3.54	3.71	3.49
T_3 ($CaCl_2$ 1.5% + LDPE bags)	3.26	3.34	3.53	3.67	3.45	3.20	3.26	3.46	3.60	3.38
T_4 (Non treated + LDPE bags)	3.50	3.73	3.84	4.00	3.76	3.49	3.63	3.78	3.94	3.71
T_5 ($CaCl_2$ 0.5 % + Gunny bags)	3.68	3.92	4.13	4.37	4.02	3.59	3.82	3.93	4.17	3.88
T_6 ($CaCl_2$ 1.0% + Gunny bags)	3.61	3.85	3.99	4.17	3.90	3.53	3.65	3.82	3.95	3.74
T_7 ($CaCl_2$ 1.5% + Gunny bags)	3.55	3.79	3.88	4.00	3.80	3.42	3.59	3.68	3.89	3.64
T_8 (Non treated+ Gunny bags)	3.73	4.37	5.00	5.63	4.68	3.79	3.98	4.16	4.31	4.06
T_9 (Control)	3.81	4.96	5.31	6.00	5.02	3.92	4.15	4.37	4.98	4.35
Mean	3.55	3.89	4.11	4.39		3.52	3.67	3.82	4.04	

Initial value	2.87	
CD (0.05)	Ambient storage	Refrigerated storage
Storage	0.043	0.040
Treatment	0.065	0.060
Storage x treatment	0.130	0.121

retention of acidity in calcium treated fruits might be due to reduction in metabolic changes of organic acid into carbon dioxide and water. These results are in agreement with those of Ibrahim (2005) who showed higher retention of acidity in calcium chloride treated apricot during storage.

The sugars increased with the advancement in storage period (Table 5 and 6). The breakdown of polysaccharides into water soluble sugar might be a reason for an increase in the sugar content. The treatment of fruits treated with calcium chloride found lower total and reducing sugar content when compared with the control both under ambient and refrigerated conditions. Similar results have been reported by Rajkumar and Mitali (2009) in waterapple fruits.

Ascorbic acid content differed significantly between the post harvest treatments and storage treatments in both ambient and refrigerated conditions (Table 7). The control fruits recorded significantly lower ascorbic acid under both storage

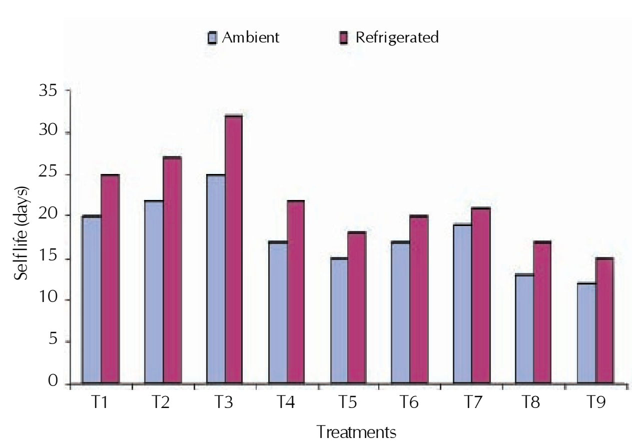

Figure 1: Effect of packaging and post harvest chemical treatments on shelf life of tomato during storage

conditions (9.36 mg/100g at ambient and 11.33mg/100g at refrigerated storage). However, the level of ascorbic acid was found to be maintained with post harvest application of calcium and its level was significantly higher in treatment T_3 (calcium chloride 1.5% + LDPE bags). Modified atmosphere packaging of tomatoes significantly maintained a higher ascorbic acid content over storage period. This could be attributed to the maintenance of higher CO_2 levels and reduced O_2 concentration under MAP. During storage, due to respiring tissue, O_2 in the vicinity is utilized and CO_2 released during respiration is maintained their exchange of gases from the ambient atmosphere. (Tasdelen and Bayindirli, 1998). The reduction of ascorbic acid according to Mapson (1970) might be due to the lowering of respiration of fruits or oxidation of ascorbic acid content of the calcium treated fruits.

Lycopene is a phytonutrient and an antioxidant and this pigment is principally responsible for the characteristic deep red colour of ripe tomato fruits (Table 8). The lycopene content differed significantly between post harvest treatments and the storage intervals. Among the storage conditions the lycopene content was higher at ambient when compared with refrigerated conditions. However, among treatments, the lycopene content was found to be higher in control set, while the chemically treated fruits packed in LDPE bags showed lesser and slow accumulation under both storage conditions. Reasons for the failure in skin colour development may be an effect of $CaCl_2$ on the ethylene generating cycle, which affects the synthesis of the pigment lycopene during the process of ripening (Njoroge *et al.*, 1998).

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