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EFFECT OF POSTHARVEST TREATMENTS ON SHELF LIFE OF LITCHI FRUITS (*Litchi chinensis* Sonn.) CV. ROSE SCENTED

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ABSTRACT : Research was carried out to evaluate the influence of various post harvest treatments on litchi fruits under cold conditions. Cold conditions increased the shelf life of litchi to 18 days. Among all the treatments, Oxalic acid (10 %) dip was most effective in retaining postharvest quality and reducing physiochemical losses. It resulted in minimum browning index (55.47) and spoilage percentage (10.14%). Physiological weight loss was also reduced to minimum (3.72%) in fruits treated with Oxalic acid (10%). Among the chemical parameters, maximum ascorbic acid content(17.69 mg/100g) and TSS (21.940Brix) were also recorded in Oxalic acid(10%) treatment.

Keywords : *Litchi, browning index, oxalic acid, post harvest, shelf life, TSS.*

The litchi (*Litchi chinensis* Sonn.) is an important subtropical evergreen fruit crop belonging to family Sapindaceae. The fruit is a valuable international fruit of peculiar pleasant flavour and attractive colour. Unfortunately this delicate and pleasant flavour begins to change as soon as the fruit is harvested from the tree. Postharvest losses of litchi are estimated to be 20%–30% of the harvested fruit and could reach as high as 50% prior to consumption (Jiang *et al.,* 2). Postharvest pericarp browning of litchi fruit results in an accelerated loss in shelf life and a reduced commercial value. Without specialized treatment, the skin browns within a day. Commercially the litchi industry is using SO_2 fumigation to control browning and minimize the post harvest losses. However it is known to have residual effects on quality and safety. Present litchi research all over the world is focused on finding a safe alternative for minimizing the postharvest losses and extending the shelf life of litchi without sacrificing its quality. Studies carried out around the world during the last four decades reveal that the storage life of litchi at ambient conditions could be extended up to 2 weeks by the application of various physical /chemical treatments and proper packaging material. Acid dips have been used to delay the onset of browning both alone and in combination with other treatments. Most commonly used are ascorbic acid, citric and oxalic acid, that are weak organic acids found in fresh fruits and are natural identical antibrowning agents and generally recognized as safe (Suttirak and Manurakchinakorn, 12). The present research was conducted during the year 2009-2011 with an objective to find out a safe chemical for extending shelf life of litchi.

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MATERIALS AND METHODS

The present study was conducted in the Post-Harvest Laboratory of the Department of Horticulture, College of Agriculture, G.B. Pant University of Agriculture and Technology, Pantnagar, U.S.Nagar (Uttarakhand). Bunches of litchi fruits, cv. Rose Scented, harvested from an orchard of Horticultural Research Centre, Patharchatta were collected in muslin cloth bags, taken to the laboratory, were selected for uniformity of size and colour and blemished and diseased fruits were discarded. Precooled fruits were dipped in the different concentrations of chemicals for ten minutes and allowed to air dry. Fruits were then kept at cold conditions (4°C ±10°C) and 85-90% R.H in sealed, perforated polyethylene bags for further studies. Thirty fruits were taken for each treatment (Table 1) and all the treatments were replicated thrice. Observations were recorded for various physical and chemical parameters of fruits at two days interval. The experiment was designed according to two way factorial completely randomized design (Factorial C.R.D).

Table 1: Details of treatments.

Treatment	Notation
Control	T_0
Benzyl adenine (10ppm)	T_1
Calcium Nitrate (1%)	T_2
Copper Sulfate (1%)	T_3
Potassium metabisulfite (600ppm)	T_4
Oxalic Acid (10%)	T_5
Silver Nitrate (1%)	T_6
Ascorbic Acid (1%)	T_7

Observations were recorded for various physical parameters of fruits viz. Physiological loss in weight, Browning index, Spoilage percentage, and chemical parameters like TSS (°Brix) and Ascorbic acid (mg/100 g pulp).

For calculating physiological loss in weight, weight of ten fruits in a polythene bag was measured regularly at fixed intervals and the rate of weight loss was calculated by the following formula and expressed as per cent:

PLW (%)

$$= \frac{\text{Initial fresh weight} - \text{weight of the fruit on date of observation}}{\text{Initial fresh weight of the fruit}} \times 100$$

Spoilage percentage was worked out on the basis of number of spoilt fruits (unfit for human consumption) observed at every one day interval, and the spoilt fruits were removed. Browning was assessed visually according to the method of Ramma (7), by measuring the total browning areas of the pericarp on each fruit in a packet. In each packet, 30 fruits were taken. Following scale was used while calculating browning index:

0= No browning; 1=slight browning

2=25% browning 3=25-50% browning

4=50-75%browning 5=>75% browning (very poor quality)

Browning index was calculated by using the following formula:

Browing Index = Σ (browning scale x percentage of corresponding fruit within each class).

Total soluble solids in the fruits were recorded at room temperature using digital hand refractometer and were expressed in terms of °Brix. Ascorbic acid content of litchi fruits was determined by 2, 6-dichlorophenol indophenol visual titration method (Ranganna, 8).

The data were analyzed according to the procedure for analysis of two factorial completely randomized design (Factorial C.R.D.) as given by Snedecor and Cochran (11). The overall significance of differences among the treatments was tested, using critical difference (C.D.) at 5% level of significance. Pooled data for both the years is presented

RESULTS AND DISCUSSION

Data regarding spoilage percentage (Table 2) indicated clearly that Oxalic acid 10% (T_5) recorded minimum (10.14%) spoilage and T_0 (control) recorded maximum spoilage (35.66 %). Fruit spoilage increased with increase in the duration of storage. No spoilage was observed on the initial day of storage Spoilage reached a maximum level (49.87%) on the 18th day of storage from a minimum level (6.02%) on 2nd day of storage. Similar reduction in spoilage by application of oxalic acid was reported by Johnson *et al.* (3) and Sivakumar *et al.* (10). They further stated that less spoilage by oxalic acid dipping treatment might be due to the effect of fungistatic action of oxalic acid.

Data for browning index (Table 3) revealed that Oxalic acid (10%) dip proved to be most efficient in reducing browning. Maximum browning index (285.07) was recorded in T_0 (control) while minimum (55.47) in T_5 (Oxalic acid 10%). Browning index (59.53) was also reduced significantly in Ascorbic acid 1% (T_7) as compared to T_0 (control). The above findings corroborate with the finding of Saengnil *et al.* (9) and Pathak and Chakraborty (5).

Marked variation was observed among the effect of various treatments on physiological loss in weight of litchi fruits at different days of storage (Table 4).

Table 2 : Effect of treatments on spoilage percentage (%).

Treatments	Storage period (Day)										Mean
	0	2	4	6	8	10	12	14	16	18	
T_0	0.00	11.23	16.18	20.12	28.30	36.19	48.69	55.99	67.18	72.73	35.66
T_1	0.00	7.54	13.84	18.89	21.33	27.99	39.82	45.69	49.90	62.08	28.71
T_2	0.00	5.06	7.89	14.55	17.06	18.57	20.42	26.67	36.03	43.79	19.00
T_3	0.00	8.20	14.77	17.36	29.42	33.91	45.63	53.09	58.09	61.70	32.22
T_4	0.00	7.86	9.89	14.70	17.47	23.03	27.68	37.02	44.41	52.16	23.42
T_5	0.00	0.00	0.00	3.97	10.78	12.81	14.72	17.83	19.77	21.56	10.14
T_6	0.00	8.30	12.01	17.05	24.71	29.85	36.21	46.26	50.84	59.88	28.51
T_7	0.00	0.00	5.02	8.06	13.35	15.74	17.81	20.19	22.28	25.06	12.75
Mean	0.00	6.02	9.95	14.34	20.30	24.76	31.37	37.84	43.56	49.87	23.80
CD (P = 0.05)	Treatments (A) : 0.83				Storage period (B) : 0.92				A × B : 0.26		

Maximum physiological loss in weight (7.58%) was recorded in T_0 (Control) while minimum (3.72%) was recorded in T_5 (Oxalic acid 10%). The reduced weight loss in oxalic acid might be due to retardation of respiration and enzymatic activities responsible for disorganization of cellular structure. Calcium nitrate (1%) dips and ascorbic acid (1%) dips were also found effective in reducing weight loss. Post-harvest treatment of apples with calcium nitrate reduced the physiological loss in weight (Rabiei *et al.,* 6).With the advancement of storage period, it was observed that there occurs a significant change in weight loss of fruits under all treatments.

Data presented in Table 5 revealed that maximum TSS (21.94°Brix) were recorded in Oxalic acid 10% (T_5) and minimum TSS (21.38°Brix) was recorded in Copper sulfate 1% (T_3). Less decline in TSS by oxalic acid due to decline in TSS might be due to less breakdown and utilization of polysaccharides into simple sugars by decrease in water loss and evapo-transpiration and other biochemical activities. Increment in shelf life and quality attributes by the use of calcium salts in mango (Dhillon and Kaur, 1) and guava (Kumar *et al.,* 4) is also corroborated present investigation.

Table 3: Effect of treatments on browning index.

Treatments	Storage period (Day)										Mean
	0	2	4	6	8	10	12	14	16	18	
T_0	0.00	57.83	128.02	257.16	288.79	35.69	390.02	441.96	468.88	482.41	285.07
T_1	0.00	27.77	57.11	118.26	189.18	198.27	218.85	255.73	305.23	318.29	168.87
T_2	0.00	23.62	35.21	55.32	104.89	135.17	155.42	172.93	191.98	208.24	108.28
T_3	0.00	46.39	92.00	121.77	185.54	205.34	236.45	268.01	316.81	341.36	181.37
T_4	0.00	33.10	44.11	66.55	117.94	158.39	178.98	211.35	227.82	242.94	128.12
T_5	0.00	0.00	9.52	19.65	31.59	44.34	64.73	117.73	126.15	140.98	55.47
T_6	0.00	50.81	64.80	89.17	153.15	181.04	192.77	209.43	227.22	255.21	142.36
T_7	0.00	0.00	13.97	23.33	40.25	46.44	68.23	120.17	133.25	149.64	59.53
Mean	0.00	29.94	55.59	93.90	138.92	163.08	188.18	224.66	249.66	267.38	141.13
CD (P=0.05)	Treatments (A) : 0.10				Storage period (B) : 0.11					A × B : 0.32	

Table 4 : Effect of treatments on physiological loss in weight (%).

Treatments	Storage period (Day)										Means
	0	2	4	6	8	10	12	14	16	18	
T_0	0.00	1.52	3.47	4.80	7.28	9.35	10.33	12.17	13.20	13.70	7.58
T_1	0.00	2.08	2.81	3.68	5.81	6.41	7.33	8.34	9.45	10.90	5.68
T_2	0.00	1.32	1.91	2.82	3.89	4.79	5.74	7.08	8.18	8.81	4.45
T_3	0.00	2.08	3.41	5.08	5.84	7.44	8.46	9.33	10.11	10.97	6.27
T_4	0.00	1.98	3.39	4.92	5.60	6.24	7.35	8.32	9.08	10.29	5.72
T_5	0.00	1.41	1.80	2.31	2.84	3.58	5.10	5.89	6.88	7.40	3.72
T_6	0.00	1.94	3.07	3.89	5.53	6.70	8.26	8.94	9.81	10.86	5.90
T_7	0.00	1.50	1.79	3.00	3.50	4.31	5.36	6.61	7.16	8.10	4.13
Means	0.00	1.73	2.70	3.81	5.03	6.10	7.24	8.33	9.23	10.13	5.43
CD (P=0.05)	Treatments (A) : 0.92				Storage period (B) : 0.10					A × B : 0.29	

Table 5 : Effect of treatments on TSS (°Brix).

Treatments	Storage period (Day)										Mean
	0	2	4	6	8	10	12	14	16	18	
T_0	20.76	21.09	21.58	22.11	21.95	21.79	21.55	21.44	21.33	21.18	21.48
T_1	20.09	21.13	21.58	21.98	21.84	21.77	21.6	21.62	21.59	21.54	21.48
T_2	20.40	21.00	21.56	21.97	21.88	21.84	21.80	21.75	21.71	21.66	21.55
T_3	20.60	21.64	21.77	21.85	21.67	21.47	21.40	21.27	21.17	21.00	21.38
T_4	20.85	21.43	21.73	21.85	21.74	21.66	21.59	21.48	21.37	21.30	21.50
T_5	20.98	21.57	21.90	22.25	22.20	22.17	22.14	22.10	22.07	22.04	21.94
T_6	20.92	21.35	21.75	21.96	21.84	21.72	21.52	21.42	21.33	21.25	21.50
T_7	20.69	21.26	21.70	21.90	22.01	21.96	21.90	21.71	21.64	21.61	21.64
Mean	20.66	21.31	21.69	21.98	21.89	21.80	21.69	21.60	21.52	21.44	21.56
CD (P = 0.05)	Treatments (A) : 0.51				Storage period (B) : 0.69				A × B : 0.26		

Table 6 : Effect of treatments on ascorbic acid (mg/100g).

Treatments	Storage period (Day)										Means
	0	2	4	6	8	10	12	14	16	18	
T_0	28.21	25.55	22.43	19.88	15.32	11.13	9.65	5.54	2.85	1.36	14.19
T_1	27.69	25.97	24.55	21.97	19.01	16.19	13.75	9.66	6.23	3.26	16.83
T_2	28.44	25.69	23.62	21.65	18.92	15.56	13.03	10.13	7.99	4.69	16.97
T_3	28.39	25.95	22.08	17.91	15.48	12.39	8.96	6.66	5.58	4.71	14.81
T_4	28.39	25.33	21.70	17.70	15.44	11.58	7.27	5.21	4.58	4.04	14.12
T_5	28.62	26.71	24.09	20.47	18.94	17.68	14.05	11.10	8.52	6.71	17.69
T_6	28.60	26.50	21.69	16.73	13.81	11.50	8.27	5.81	4.65	3.47	14.10
T_7	28.58	26.73	22.61	20.20	15.47	13.83	10.89	9.13	7.32	5.81	16.06
Means	28.36	26.05	22.85	19.56	16.55	13.73	10.73	7.90	5.96	4.25	15.60
CD (P = 0.05)	Treatments (A) : 0.11					Storage period (B) : 0.12			A × B : 0.35		

During ambient and cold storage condition, Oxalic acid (10%) retained maximum ascorbic acid till the last day of storage. Maximum ascorbic acid (17.69 mg/100g) was recorded in Oxalic acid 10% (T_5) and minimum (14.10 mg/100g) in Silver Nitrate 1% (T_6).This higher retention might be due to continued synthesis of L-ascorbic acid from its precursor, glucose-6-phosphate and additive effect of slow rate of oxidation in respiration process during the storage period. Maintainenanace of higher ascorbic acid content by oxalic acid may due to the inhibitory effect on ascorbic acid oxidation (Tannerrbaum *et al.,* 13).

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