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Effect of chemical coating and other treatments on physico-chemical changes during storage of Litchi fruits (*Litchi chinensis* Sonn.) cv. Deshi

AK Singh, Ranju Kumari and JN Singh

Abstract
Fruits of litchi are highly perishable and losses its commercial value within two days at room temperature. Due to rapid skin discolouration. The experiment was conducted at Department of Horticulture, Institute of Agriculture Sciences, BHU., Varanasi to find out the effect of post-harvest application of dipping in different concentrations of $CaNO_3$ (1 %, 1.5% and 2 %) and hot water treatment for five minutes followed by fruit wrapping in newspaper and polythene on physico-chemical changes during storage of litchi (*Litchi chinensis* Sonn.) cv. Deshi. Fruits without treatment were considered as control. The experiment was conducted in completely randomized design with three replications and observations were recorded on alternate day up to 13 days of storage. It was observed that fruits showed minimum reduction in size in respect of length and width (4.03 & 4.26 % respectively) in treatment (T10) with 2.0% calcium nitrate with perforated polythene wrapping (T10) and maximum reduction (12.77 and 12.57% respectively) in untreated fruits (T11). Minimum reduction of volume (15.00) was observed in polythene wrapping treated (T_6 and T_7) fruits. Minimum pH (4.9) was observed in calcium nitrate (2.0%) + polythene wrapping (T10) on 11th days. It was observed that significantly maximum quantity of ascorbic acid 34.85 mg/100g, 35.00mg/100 g and 35.00mg/100 g was recorded in T9, T8 and T10 treatments respectively on 11th day of storage. Thus, it can be suggested that fruit dipping in calcium nitrate at 2.0 per cent with polythene wrapping (20% vent) is better for increasing the storage life of litchi at room temperature.

Keywords: Litchi, Post-harvest treatment, Calcium nitrate, pH, Ascorbic acid

Introduction
The litchi is one of the most important evergreen sub-tropical fruit plant of family Sapindaceae having excellent fruit quality, pleasant flavour, juicy flesh (aril) and attractive appearance. It is also called as queen-of-fruits because it requires highly specific climatic conditions for its cultivation. Harvested fruits losses its commercial value within two days at room temperature due to rapid skin browning and shrivelling. Unfortunately, the luscious litchi fruit has very poor storability, therefore much emphasis to be given to enhance post harvest life so that litchi fruits can be enjoyed for more days. Postharvest losses of litchi fruit was estimated to be 20-30% of harvest and could reach as high as 50% prior to consumption (jiang *et al*., 2001).
Commercial the quality of litchi fruits can be judged best by considering the physical composition like shape, size, colour, taste, flavour, pulp-stone ratio and chemical composition like TSS and ascorbic acid contents etc. Keeping quality of fruits would be enhanced by inhibiting polygalacturonase, the vital enzyme for fruit ripening, by inhibiting the synthesis of fruit- ripening enzyme through antisense technique. Besides, this Various chemicals including calcium compounds are reported to extend the storage life of many fruits by maintaining their firmness and minimizing respiration rate, proteolysis, disease incidence, colour and tissue break down thus reducing the per cent loss in weight (Gupta *et al*., 2015; Jhalegar *et al*., 2015; Tarula *et al*., 2015). Pericarp browning is the first visual sign of fruit deterioration which has been extended up to 9 days at ambient conditions by treating fruit with chemicals along with packaging in transparent perforated polythene (Neog and Saikia, 2010). Recent research had focused on reducing these major post harvest problems with the help of wrapper with different cushioning materials, plant-growth regulators, SO_2 fumigation and acid dip, hot water dip treatments to minimize these changes in litchi and other fruits (Neog and Saikia, 2010; Pandey and Lal 2014; Jhalegar *et al*., 2015). Studies have indicated that calcium compounds are known to extend the storage life of many fruits by maintaining firmness and minimizing the rate of respiration, protein break down and disease incidence (Gangwar *et al*., 2012). Keeping the above facts in view the present investigation will be carried out with an objective to study the suitable measures for extending the storage life of litchi fruits cv. Deshi at ambient

temperature.

Methods

The present investigation was conducted at Department of Horticulture Institute of Agriculture Sciences, BHU., Varanasi to evaluate the effect of chemical coating and other treatments on Physico-Chemical Changes during Storage of Litchi fruits (*Litchi chinensis* Sonn.) cv. Deshi at ambient temperature. Litchi fruit of similar shape and size were collected from the tagged plant. Physico-chemical composition of fresh fruits was recorded immediately after the harvest. The average maximum and minimum temperature of the storage room was 34^0c ± 2^0c and relative humidity was 51% ± 5%. The total number of treatments was eleven, replicated three times in completely randomised design (CRD). Eleven (11) treatments given were T_1 – News paper wrapping, T_2 – News paper wrapping + hot water treatments 50 ± 2 ºC for 5 minutes, T_3 – News paper wrapping + calcium nitrate 1.0 %, T_4 – News paper wrapping + calcium nitrate 1.5 %, T_5 – News paper wrapping + calcium nitrate 2.0 %, T_6 – Polythene wrapping (20% ventilated), T_7 – Polythene wrapping + hot water treatments 50 ± 2 ºC for 5 minutes, T_8 – Polythene wrapping + calcium nitrate 1.0 %, T_9 – Polythene wrapping + calcium nitrate 1.5 %, T_{10} – Polythene wrapping + calcium nitrate 2.0 %, T_{11} – Control. The fruits were store at room temperature in different lots consisting of 200 fruits per treatment per replication. At the start of the experiment these two hundred fruits were kept in two lots of 100 fruits each in bamboo baskets. One lot was fixed for recording change in fruits size, volume, specific gravity and other lot for chemical analysis i.e., pH & ascorbic acid. The storage was terminated on the day when the fruits of last treatment exhibited fifteen per cent or above spoilage loss. Observations on physico-chemical parameters of fruits, viz. length(cm), width (cm), volume(cc), specific gravity, pH, ascorbic acid(mg/100g) content were recorded. The percentage change in size of fruits sample was calculated by difference between initial length or diameter and final length or diameter divided by initial length or diameter multiplied by 100. Ten randomly marked fruits per treatment were taken out and the volume in milli litre was recorded replication wise using calibrated container i.e., measuring cylinder. The volume of the fruits was recorded by water displacement method of Gustafson (1926).

The specific gravity of the fruits was determined by dividing the weight of the fruits in air by the volume of the fruits as obtained by water displacement method. pH in juice was measured directly with the help of systronic pH metre. Ascorbic acid in litchi pulp was estimated by 2, 6-Dichlorophenol-indophenol visual titration method as described by Ranganna (1986). The data were subjected to statistical analysis as per the method given by Gomez and Gomez (1986).

Results and Discussion

Data regarding change in size of during storage (Table 1) showed minimum reduction in length and width (4.03 & 4.26 % respectively) of fruits treated with 2.0% calcium nitrate with perforated polythene wrapping (T10) and maximum reduction (12.77 and 12.57% respectively) in untreated fruits (T11). Reduction in fruits size were observed in all treatments but highest reduction was founded in untreated fruits. Reduction in volume (Table 2) was also reported in all treatments during storage. The minimum reduction in volume ranged from 15.00 to 17.81 per cent in T6, T7, T8, T9, and T10 and maximum reduction ranged from 24.44 to 24.80 per cent in rest of the treatments including control from first to eleventh day of storage. Minimum reduction (15.00) was observed in T_6 and T_7 treatments. It is quite evident from observation (Table 1and 2) that polythene wrapping with 20 per cent vent has contributed to a greater extent in maximising the reduction of volume of the fruit during storage irrespective of other treatment. Gaur and Bajpai (1978) found almost similar results in litchi using polythene bags. The lesser decrease in size and volume of fruits might be attributed to the lesser contraction of cells and reduction in the area of intercellular spaces due to higher percentage of humidity around the outer layer of the fruits. Effect of pre harvest spray of higher concentration of Calcium nitrate on fruit size were also reported in guava (Bisen *et al*., 2014).

Table 1: Change in size of litchi cv deshi fruits during storage.

Treatment	Length(cm)				Width(cm)			
	1st day	11th day	Decrease	Decrease (%)	1st day	11th day	Decrease	Decrease (%)
T1	3.85	3.47	0.38	9.87	3.60	3.25	0.35	9.72
T2	3.80	3.47	0.33	8.68	3.63	3.35	0.28	7.71
T3	3.82	3.50	0.32	8.38	3.60	3.31	0.29	8.05
T4	3.70	3.39	0.31	8.38	3.51	3.22	0.29	8.26
T5	3.75	3.44	0.31	8.27	3.52	3.22	0.30	8.52
T6	3.80	3.56	0.24	6.32	3.60	3.36	0.24	6.67
T7	3.65	3.40	0.26	7.12	3.46	3.23	0.23	6.65
T8	3.80	3.64	0.16	4.21	3.61	3.45	0.16	4.43
T9	3.70	3.54	0.16	4.32	3.55	3.38	0.17	4.79
T10	3.72	3.57	0.15	4.03	3.52	3.37	0.15	4.26
T11	3.68	3.21	0.47	12.77	3.42	2.99	0.43	12.57
SE(m) ±	0.06	0.90			0.05	0.07		
CD at 5%	NS	0.21	-	-	NS	NS	-	-
CV %	0.17	1.34			0.15	0.24		

Table 2: Change in volume (cc) of litchi fruits cv. deshi during storage.

Treatments	Cultivar- Deshi			
	1st day	11th day	Difference	% of loss
T_1	16.49	12.40	4.09	24.80
T_2	16.56	12.51	4.05	24.46
T_3	16.53	12.45	4.08	24.68
T_4	16.45	12.43	4.02	24.44
T_5	16.78	12.67	4.11	24.49
T_6	16.87	14.34	2.53	15.00
T_7	16.40	13.94	2.46	15.00
T_8	16.43	13.51	2.92	17.77
T_9	16.55	13.62	2.93	17.70
T_{10}	16.68	13.71	2.97	17.81
T_{11}	16.77	12.65	4.12	24.57

Changes in pH during storage (Table 3) revealed that pH was higher in case of untreated fruits (T11) in comparison to treated fruits. Minimum pH (4.9) was observed in treatment T10 on 11th days whereas T8, T9 and T10 showed pH 5.1 on 13th days of storage. The fruits treated with calcium nitrate 2.0, 1.5 and 1.0 per cent in combination with perforated polythene exhibited 4.9, 5.0 and 5.0 pH respectively which were at par with each other. Increase in pH during advances in storage period was also reported by Gousia *et al.*, (2009) in mandarin and Sabato *et al*., (2009) in mango. pH was found to be correlated with the acidity of the fruits. The acidity of the fruits decreased continuously during storage. The rapid utilization of acids of pulp in the respiratory process might have caused the rapid increase in pH. The treatment of calcium might have induced some buffer action on hydrogen ion during storage affecting slow rate of pH enhancement.

Table 3: pH of litchi cv. Deshi fruits during storage.

Treatments	1st day	3rd day	5th day	7th day	9th day	11th day	13th day
T1	3.90	4.20	4.40	5.00	5.30	5.40	5.60
T2	3.80	4.10	4.30	4.70	5.00	5.30	5.50
T3	3.70	4.10	4.30	4.70	4.90	5.30	5.40
T4	3.90	4.20	4.40	4.60	4.90	5.20	5.30
T5	3.90	4.20	4.50	4.70	4.90	5.30	5.40
T6	3.90	4.10	4.30	4.60	4.80	5.10	5.20
T7	4.00	4.20	4.30	4.50	4.80	5.10	5.20
T8	3.70	4.00	4.20	4.40	4.70	5.00	5.10
T9	3.95	4.10	4.30	4.40	4.70	5.00	5.10
T10	3.80	4.10	4.30	4.50	4.70	4.90	5.10
T11	3.90	4.40	4.70	5.10	5.50	5.80	6.00
SE (m) ±	0.00	0.14	0.16	0.13	0.13	0.14	0.16
CD at 5%	0.00	0.42	0.47	0.37	0.38	0.41	0.47
CV %	0.00	0.38	0.41	0.30	0.30	0.30	0.34

Data (Table 4) indicated a gradual decrease of ascorbic acid during storage. It was observed that significantly maximum quantity of ascorbic acid 34.85 mg/100g, 35.00mg/100 g and 35.00mg/100 g was recorded in T9, T8 and T10 treatments respectively which were statistically at par on 11th day of storage. Significantly minimum quantity of ascorbic acid 23.50 (mg/100g) was retained in fruits of control (T11) on the same day. The maximum decline was observed in fruits of control which was statistically at par with news paper wrapped fruits' and least decline was found in case of fruits treated with calcium nitrate 1.0, 1.5, 2.0 percent in combination with perforated polythene bags. The higher amount of ascorbic acid in treated fruits might be due to retarded oxidation process and thereby lowering down the rate of conversion of ascorbic acid to the dehydro-ascorbic acid. Activities of oxidising enzymes might be reduced in the treated fruits that resulted the higher level of ascorbic acid content up to last day of storage. Similar finding was also reported earlier by Mahajan *et. al.,* (2005) in Kinnow mandarin and Pandey and Lal (2014) in litchi.

Table 4: Ascorbic acid (mg/100g) of litchi Cv. Deshi fruits during storage.

Treatment	Pooled data						
	1st day	3rd day	5th day	7th day	9th day	11th day	13th day
T1	45.25	43.85	40.85	37.40	32.70	26.60	21.40
T2	45.10	44.15	41.45	38.65	33.60	29.65	23.30
T3	45.30	44.40	42.25	39.30	34.30	30.50	23.95
T4	45.25	44.10	41.85	39.75	34.45	30.63	24.65
T5	45.20	44.25	42.25	39.95	34.50	30.45	24.60
T6	45.30	44.45	43.10	40.95	38.70	32.60	25.35
T7	45.35	44.25	43.10	41.80	38.85	34.52	26.75
T8	45.35	44.10	43.05	41.40	39.00	35.00	27.45
T9	45.40	44.25	42.85	41.15	38.90	34.85	27.40
T10	45.15	44.05	43.10	41.45	39.10	35.00	27.60
T11	45.15	42.90	38.45	34.62	28.27	23.50	17.95
SE (m) ±	0.00	0.24	0.30	0.45	0.42	0.44	0.47
CD at 5%	0.00	0.70	0.87	1.30	1.21	1.28	1.36
CV %	0.00	0.06	0.08	0.13	0.13	0.16	0.21

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