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Effect of Wrapping Material and Chemicals on Post- Harvest Behavior of Litchi (*Litchi chinensis* Sonn.) cv Deshi

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Abstract The most important post harvest need of litchi is the retention of fruit color and quality for longer period. .The experiment was conducted to sec the effect of various wrapping material and chemicals on the storage behavior of litchi fruits after harvest. Completely randomized design (CRD) with eleven treatments which replicated thrice were used for evaluation of the treatment. Uniform size fruits were harvested at the physiological maturity and treated in different concentration of chemicals for 5 min at room temperature then respective wrapping materials were used. The physiological loss in weight was significantly maximum in control (33.50%) and minimum (19.95%) in fruits treated with 2.0 % calcium nitrate under perforated polythene bags on 13th day of storage. Whereas, fruits treated with hot water treatment under perforated polythene retained maximum TSS (23.25 ^{0}Brix). The total soluble solids increased during storage up to 5th day but in some treatments up to 11th day and declined after that in all the treatments except the fruits stored in perforated polythene in combination with calcium treatments.

Keywords Litchi, Post harvest treatments, Calcium nitrate, Physiological weight loss, TSS.

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Introduction

India has emerged as the second largest producer of litchi (*Lttchi chinensis* Sonn.) in the world with, a total production of 5.85 lakh MT from the 84.17 thousand hectare area during 2013-14 [1]. Litchi, the fruit of high commerce, is rightly nicknamed as queen-of-fruits. Since its fruits are very delicate and lose their shape and overall beaty within 24-36 h. The famous Chinese proverb also explain, once litchi fruit detached from the tree, off-color happens in the first day : off-fragrance in the second day; off-flavor in the third and all gone after four to five days. Due to highly perishable nature of the fruit litchi needs proper handling and storage. The most important post harvest need of litchi is the retention of fruit color and quality for longer period so that the marketing be regulated to avoid the glut and ensure better return to the growers. Losses in fruit quality are mostly due to its relatively high metabolic activity during storage and post harvest calcium application maintains cell turgor, membrane integrity, tissue firmness and delays membranc lipid catabolism, extending storage

life of fruits [2]. Exogenosly applied calcium stabilizes the plant cell wall and protects from cell wall degrading enzymes [3]. Calcium nitrate treatment significantly reduced the physiological loss in weight, exihibited better quality on account of its favorable effect on total soluble solids was also reported in apple fruit [4] and aonla fruit [5]. Packaging materials by establishing a favorable conditions inside the package which maintained the superior quality and shelf-life of fruit as lower weight loss, desirable firmness and total soluble solid [6]. Therefore, an experiment was conducted to find out the effect of different treatments on the storage behavior of litchi for regulation of marketing and its use in processing industries.

Materials and Methods

Uniform size fruits of litchi cv Deshi were harvested at the physiolgical maturity and treated in various treatments for 5 min at room temperature. The average maximum and minimum temperature of the storage room was $34^0C \pm 2^0C$ and relative humidity was 51% ± 5%. The total numbers of treatments were eleven, replicated three times in completely randomized design (CRD). Fruits were stored at room temperature in different lots consisting of 200 fruits per treatments 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 frxed for recording physiological loss in weight and other lot for chemical analysis i.e., TSS. The storage was terminated on the day when the fruits of last treatment exhibited 15% or above spoilage loss. Just harvested fresh fruits were taken for 11 different post harvest treatment combinations i.e., T_1- News paper wrapping, T_2- News paper wrapping + Hot water treatments 50 ± 1^0C 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, T_7 - Polythene wrapping + Hot water treatments at 50 ± 1^0C 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 cumulative physiological loss in weight (PLW) of the fruits in per cent was calculated by difference between initial weight and final weight divided by initial weight multiplied by 100. The raw data in terms of percentage were converted into degree (Angular value by the method of transformation). The TSS of fruits (^{0}Brix) was recorded with the help of hand refractometer on alternate day. The data were subjected to statistical analysis as per the method given by Gomez and Gomez [7].

Results and Discussion

The effect of different wrapping materials and chemicals on the cumulative physiological loss in weight per cent and total soluble solid were observed on alternate day in two successive years for deshi cultivars of litchi during storage. The pooled data of the value thus obtained were presented in Tables 1 and 2 and illustrated graphically in Figures 1 and 2. The pooled data of two years (Table 1 and Fig. 1) for indicated the superiority of calcium nitrate treated fruits with perforated polythene bags in minimizing the physiological loss in weight during storage. It was observed that there was gradual increase in physiological loss in weight of litchi during storage, but the rate of increase differed amongst the treatments. Generally maximum rate of increase in physiological loss in weight was observed in untreated fruits (T_{11}) and minimum loss was recorded in fruits treated with different concentrations of calcium nitrate and kept in perforated polythene bags. Significantly minimum physiological loss in weight was observed in both T_8 (1% calcium nitrate with perforated polythene) and T_{10} (2.0% calcium nitrate with perforated polythene) and finally equal value of 19.95% was observed on 13^{th} day of storage. These treatments were significantly superior to other treatments which were closely followed by T_9 (1.0% calcium nitrate with perforated polythene) and T_7 (hot water with perforated polythene) showing 20.95 and 21.15% physiological loss in weight respectively on same day. Significantly maximum physiological loss in weight (33.50%) was recorded in fruits of control (T_{11}) on the 13^{th} day of storage. The fruit exhibited lower physiological loss in weight when treated with different concentrations of calcium nitrate as compared to untreated ones. The higher weight loss of untreated fruits is due to increased storage breakdown associated with higher respiratory rate as compared to calcium treated fruits.

Table 1. Cumulative physiological loss in weight (PLW%) of litchi cv Deshi fruits during storage.

Treat-ments	1st day	3rd day	5th day	Pooled date 7th day	9th day	11th day	13th day
T_1	0.00	5.90 (14.05)	10.40 (18.80)	16.45 (23.91)	23.05 (28.68)	28.70 (32.38)	31.85 (34.34)
T_2	0.00	5.70 (13.80)	10.30 (18.70)	15.80 (23.41)	22.50 (28.30)	28.35 (32.15)	31.65 (34.22)
T_3	0.00	5.55 (13.74)	10.30 (18.70)	15.95 (23.53)	22.40 (28.58)	28.35 (32.15)	31.55 (34.16)
T_4	0.00	5.50 (13.55)	10.25 (18.66)	15.85 (23.45)	27.95 (23.93)	28.25 (32.09)	31.55 (34.16)
T_5	0.00	5.45 (13.49)	10.10 (18.51)	15.80 (23.41)	22.10 (28.03)	28.25 (32.09)	30.85 (33.72)
T_6	0.00	1.45 (6.91)	5.05 (12.97)	10.15 (18.57)	14.35 (22.25)	18.05 (25.13)	21.35 (27.51)
T_7	0.00	1.45 (6.91)	4.95 (12.84)	10.00 (18.42)	15.20 (22.93)	18.50 (25.46)	21.15 (27.36)
T_8	0.00	1.40 (6.79)	4.60 (12.72)	10.15 (18.57)	15.00 (22.77)	18.55 (25.50)	19.95 (26.51)
T_9	0.00	1.40 (6.79)	4.75 (12.58)	9.95 (18.38)	14.95 (22.73)	18.55 (25.50)	20.95 (27.23)
T_{10}	0.00	1.40 (6.79)	8.20 (16.27)	10.05 (18.47)	14.85 (22.65)	18.55 (25.50)	19.95 (26.51)
T_{11}	0.00	6.70 (14.99)	11.80 (20.08)	18.55 (25.50)	24.35 (29.55)	29.90 (33.13)	33.50 (35.34)
SE (m) ±	0.00	0.26	0.57	0.20	0.14	0.10	0.11
CD at 5%	0.00	0.77	1.65	0.57	0.41	0.30	0.32
CV%	0.00	0.28	0.39	0.10	0.06	0.04	0.04

Calcium applications have been known to be effective in term of membrane functionality and integrity maintenance which may be the reason for the lower weight loss found in calcium treated fruits [4]. On the basis of above results it can safely be inferred that all the concentrations of calcium treatment with wrapping were significantly most superior in minimizing the physiological loss in weight. Calcium nitrate as post-harvest treatment has reported to reduce the physiological loss in weight by maintaining flesh firm-

Table 2. Total soluble solids (^{0}Brix) of litchi cv Deshi fruits during storage.

Treat-ments	1st day	3rd day	5th day	Pooled data 7th day	9th day	11th day	13th day
T_1	18.20	20.55	22.00	23.00	21.95	20.70	20.00
T_2	18.05	20.60	21.50	22.75	23.00	21.80	20.35
T_3	18.20	20.60	21.40	22.65	23.05	21.95	20.90
T_4	18.15	20.55	21.45	22.65	23.15	22.10	20.95
T_5	17.85	20.50	21.55	22.55	23.10	21.80	21.05
T_6	18.20	19.45	20.40	21.50	22.50	22.80	22.20
T_7	18.10	19.70	20.20	21.35	22.55	23.25	22.55
T_8	18.05	19.25	20.30	21.20	22.70	23.20	22.55
T_9	17.90	19.20	20.20	21.20	22.70	23.20	22.60
T_{10}	18.05	19.15	20.20	21.10	32.65	23.20	22.65
T_{11}	18.15	21.20	23.25	21.60	20.55	19.75	19.05
SE (m) ±	0.00	0.39	0.30	0.33	0.26	0.32	0.29
CD at 5%	0.00	1.13	0.87	0.96	0.76	0.94	0.86
CV %	0.00	0.21	0.16	0.17	0.13	0.16	0.15

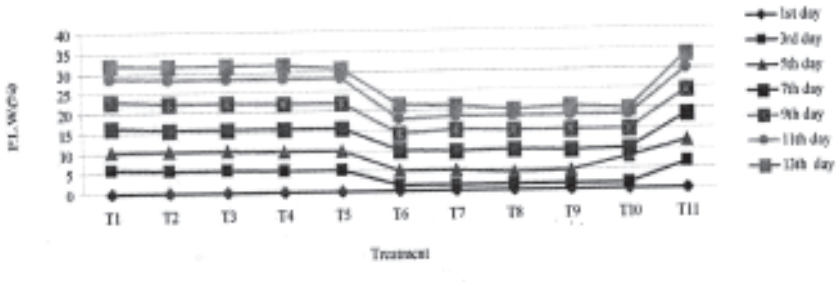

Fig. 1. Cumulative physiological loss in weight (PLW%) of litchi cv Deshi fruits during storage (pooled data).

ness and retarding the rate of transpiration through fruit surface in aonla [5], peach [8] and guava [9]. Similar findings were reported by Chaiprasert [10] and Meena et al. [11]. The results were also in line of earlier findings of Jadhao et al. [12] and Deb et al. [13] in fruits of mandarin and Mahajan et al. [6] in pear. The effect of other surface coating materials for extending the shelf- life of fruit were also reported [14–18].

The effect of different wrapping materials on the physiological weight losses was observed that fruits under all the treatments lost their weight gradually with increasing storage period being maximum in untreated fruits (control) followed by news paper wrapped fruits, then the polythene wrapped and lesser with varying degree in polythene wrapped fruits specially in those which were pre-treated (Table 1and Fig. 1). The maximum loss of weight in control (T_{11}) might be due to maximum loss of moisture caused by higher rate of transpiration and respiration through uninterrupted atmospheric column under higher temperature and less relative humidity in comparison to wrapped and treated fruits. Neog and Saikia [19] reported that chemical treated and packed in perforated polythene bags control pericarp browning and browning attributing factors which extended shelf life up to 9 days in case of litchi. The basic principal of packaging technology is that package and sealed with polymeric films established a condition with high CO_2 and low oxygen which helps in maintaining the quality and increase the shelf-life of fruit. Effect of different wrapping material on enhancement of shelf life in relation to lower weight loss and increased TSS were also studied in pear [6] and apple [20].

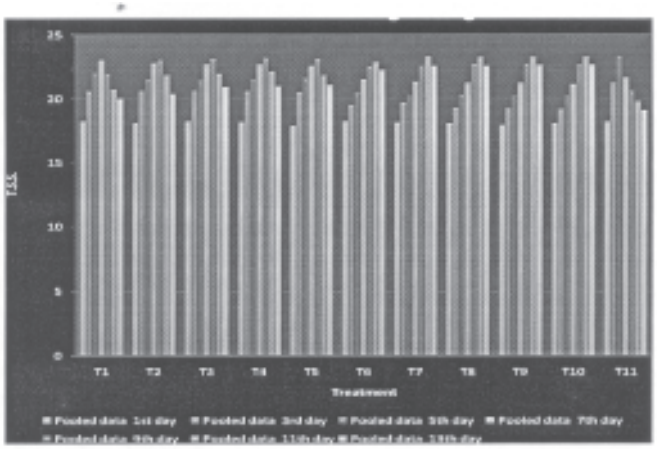

Fig. 2. Total soluble solids (^{0}Brix) of litchi cv Deshi fruits during storage (pooled data).

The pooled data of both years (Table 2 and Fig. 2) indicated significantly maximum TSS 22.80 to 23.25 ^{0}Brix in stored fruits of treatments of T_6, T_7, T_8, T_9 and T_{10}, which were statistically at par on 11th day of storage. In this cultivar significantly minimum TSS 19.75 ^{0}Brix was obtained in the fruits of control T_{11} on the same day of storage. On the basis of above results it could be inferred that application of different concentrations of calcium nitrate in combination with perforated polythene bags was most effective in increasing and retaining the TSS of stored fruits. Perforated polythene wrapping alone was also effective in this regard. The total soluble solids content of the fruits increased gradually under storage up to 5th day of storage afterwards it decreased except perforated polythene wrapped fruits treated with different concentration of calcium nitrate which expressed maximum TSS on the 13th day when storage was terminated. Increase in TSS content indicating that the sugars are assimilated in fruits as polysaccharides, which converted into soluble sugars by various hydrolyzing enzymes which enhance the TSS and sugars in the form of glucose content. Fruits treated with calcium nitrate showed significantly higher TSS over control. Effect of post harvest treatment on TSS content on different fruiuts were also reported earlier [14–18, 21]. The minimum TSS was recorded in untreated fruits (19.75 ^{0}Brix). The result is in agreement with the findings of Pandey et al. [15]. The increased conversion of starch into sugar due to activation of hydrolytic enzymes by calcium could be responsible for increases in sugar content [16,21,22]. Kumar et al. [23] also reported that aonla fruits treated with Ca $(NO3)_2$ showed maximum sugar level.

It was concluded that post harvest application of hot water treatment and calcium nitrate (2.0%) in combination with perforated polythene wrapping (20% venting) can enhanced the shelf life of litchi upto 11th days of storage.

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