IMPROVEMENT OF PERICARP COLOUR OF LITCHI FRUITS ALONG WITH REDUCTION OF PHYSIOLOGICAL LOSS IN WEIGHT AND SPOILAGE LOSS DURING STORAGE

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ABSTRACT

This study entitled "Performance of physical and chemical treatments on post harvest quality of litchi CV. Mujaffarpur" was undertaken to assess the effects of physical and chemicals treatments on fruit quality parameters after harvest under room condition. The experiment was conducted at Central laboratory of Post Harvest Horticulture, Agriculture and Forestry University, Rampur, Chitwan, Nepal from May to June in 2014 and 2015. This experiment was laid out in CRD comprising of eight treatments; Control, Distilled water dipping for 5 min, Precooling at 100C for 10 min, Precooling + Potassium metabisulphite (KMS) @ 75ppm, Precooling + Potassium metabisulphite (KMS) @ 100ppm, Potassium metabisulphite (KMS) @ 75ppm, Potassium metabisulphite (KMS) @ 100ppm and Oxalic acid @ 10%; with three replication. The temperature range and RH range during study period was 30 ± 50C and 71 ± 5% respectively. Different parameters were recorded in alternate days following post harvest treatments of litchi fruit in all the experimental units. Oxalic acid @ 10%, KMS @ 100ppm and KMS @ 75ppm resulted in more marketable and acceptable color than those with other treatments. Oxalic acid @ 10% was found superior in both the years with respect to color retention of fruit. Cumulative Physiological Loss in weight (PLW) was observed minimum with oxalic acid @ 10% (40.63%) in the first year and (30.39%) in the second year. Minimum spoilage was obtained with oxalic acid @ 10% (40.67%) in the first year and KMS @ 75ppm (46.7%) followed by oxalic acid @ 10% (51.3%) in the second year. So, the fruit could be kept in good condition for about 10 days after harvesting. Further studies using these chemicals at different concentrations as well as combinations and on other cultivar also are suggested.

Key words: *Shelf life, TSS, TA, vitamin C, Oxalic acid, Potassium metabisulphite, PLW, Spoilage loss.*

Introduction

Litchi (Litchi chinensis Sonn.) belonging to Sapindaceae family is one of the popular non-climacteric sub-tropical fruits of Nepal. It is mainly cultivated in the terai, inner terai and foothills of the Mahabharata range. Nineteen districts are categorized as the potential for litchi production (FDD, 2063/2064). The central development region has the largest area under litchi production followed by western, eastern, mid-western and far western development region. The total area and production of litchi is 8048.17 ha and 36223.5 mt respectively (APSD, 2013/14). It is suggested that the area under litchi is also increasing every year as it is found more profitable crop than mango and banana in terai (Budhathoki, 2004). The common cultivars grown in Nepal are Seedless, Muzaffarpur, Calcuttia, Early Large Red, Late Large Red, Mclean, Rose-scented, Dehradun (Shrestha, 1996; Thapa and Karmacharya, 2001). In Nepal, litchi is used very much as table purpose as this fruit is famous for its excellent quality, characteristic pleasant flavor and for attractive red colour.

The fragrant aril has a juicy texture, similar to a grape, with a unique sweet, but crisp flavor. Fruit contains carbohydrates, vitamin C, protein, fats, and minerals like calcium, phosphorus and iron with considerable amount of sugar. Skin colour is one of the major characteristics used to judge the commercial quality of litchi. The retention of fresh, red fruit colour throughout the post harvest chain has been the major focus of post harvest research in litchi. Skin browning due to moisture loss is a major limitation to the retention of colour, with litchi deteriorating rapidly after harvest, often within 2 to 3 days (Huang and Wang, 1990). Although desiccation browning of the skin may not affect the eating quality of the fruit, it greatly reduces the commercial value in market. The major limitation in litchi marketing is the rapid loss of pericarp colour after harvest, along with pericarp browning (Zhang et. al., 2005). In Nepal, litchi fruits are transported from the production sites to consumption centre.

Material and Methods

The present research was conducted at Agriculture and Forestry University, Rampur, Chitwan, in 2014 and 2015. The experiment was laid out in Completely Randomized Design (CRD) with eight treatments and each treatment was replicated three times.

Change in Peel Colour

Change in peel colour of litchi fruits (from bright red to dark brown) was evaluated by using hedonic scale of 1-5 (score).

Where, 1 = No browning

2 = Slight browning

3 = Less than 25% browning

4 = 25-50 % browning

5 = More than 50% browning

The browning was assessed by measuring the extent of the total browned area on each fruit pericarp, on the following scale (Jiang and Fu, 1999): 1 = no browning; 2 = slight browning; 3 = <1/4 browning; 4 = 1/4–1/2 browning; 5 = >1/2 browning. The browning index was calculated using the formula: P (browning scale * percentage of corresponding fruit within each class). Three replicates (50 fruit per replicate) of each treatment were carried out.

Physiological Loss in Weight (%)

All the treated fruits were weighed by using digital electronic balance on alternate days and percentage weight loss was calculated by using following formula.

$$\text{PLW (\%)} = \frac{\text{Initial weight} - \text{Final weight}}{\text{Initial weight}} \times 100$$

Here, initial weight means the initial weight of fruit under each treatment measured replication wise at the time of initiation of experiment. Similarly, final weight means fruit weight on the next observation.

Spoilage Loss (%)

Loss of fruits due to spoilage was measured regularly whenever symptom appears. Spoiled fruits were determined by visual observation i.e. fruits showing the symptoms of decay. The spoilage loss was calculated by using following formula:

$$\text{Spoilage loss (\%)} = \frac{\text{Weight of spoiled fruit}}{\text{Fresh weight of fruit}} \times 100$$

Statistical Analysis of Data

The collected data were compiled and subjected to analysis of variance using the MS-Excel program. Analysis of variance for all parameters was carried out as per the procedures given in GEN- STAT, MSTATC (Version 1.2) statistical computer package for the randomized block design (MSTATC, 1986). Duncan's Multiple Range Test (DMRT) for mean separations was done from the reference of Gomez and Gomez, (1984).

Result and Discussion

Change in Peel Colour

The effect of post harvest treatments on skin colour of litchi fruit is presented in Table 1. Significant variation in the peel colour was noticed under the influence of different post harvest treatments. Further, the progressive decreases in the red colour of skin accompanied with progressive increase in browning were observed irrespective of the treatments, On the second day of storage in 2014 experiment, fruit treated with oxalic acid @ 10% rated colour scale of 3.77 (dark red). The colour ratings with other treatments were similar with KMS @ 75ppm and KMS @ 100ppm with the rating of 3.77 and 3.83 respectively. Similarly other treatments like distilled water dipping for 5 min and precooling + KMS @ 75 ppm did not show any significant difference and rated as score of 5.67, 5.55 respectively. With control higher browning index was recorded (8.00). After second day of storage, all treatments showed more than 50% browning.

In 2015, minimum browning index was observed with oxalic acid @ 10% (4.24) where as maximum browning was observed with control (6.21) followed by distilled water dipping for 5 min (6.15).

Post harvest browning of litchi is thought to be due to the anthocyanin degradation (Zauberman et.al., 1991). The effect of oxalic acid on pericarp browning of litchi during the storage was associated with inhibition of the anthocyanin degradation rather than direct maintenance of the reddish colour of anthocyanin by pH change. The effect of oxalic acid on pericarp browning of litchi during storage was partly due to relative decrease of polyphenol oxidase activity in the fruit.

Table 1. Browning index of litchi fruit under different post harvest treatment at ordinary room temperature, 2014 and 2015

Treatments	Browning index on days indicated	
	Second days of storage	
	2014	2015
Control	8.00^{a}	6.21^{a}
Distilled water dipping	5.67^{b}	6.15^{a}
Pre cooling at 10°C for 10 min	4.71^{bc}	5.67^{ab}
Precooling + KMS @ 75ppm	5.55^{b}	5.23^{bc}
Precooling + KMS @ 100ppm	4.9^{b}	4.73^{cd}
KMS @ 75ppm	3.77^{c}	4.6^{cd}

KMS @ 100ppm	3.83^{c}	4.63^{cd}
Oxalic acid @ 10%	3.77^{c}	4.24^{d}
LSD (5%)	0.938	0.70
SEM±	0.313	0.23
CV	10.8	7.8

Means within the column followed by same letter do not differ significantly at 5% level by DMRT.

Physiological Loss in Weight

Effect of post harvest treatments on physiological loss in weight (PLW) of litchi fruit is presented in Table 2. From the observation of table it is clear that there was continued increase in weight loss of litchi fruit with prolongation of storage period irrespective of the treatments. The significant variation regarding physiological loss in weight was noticed on second days onward in different post harvest treatments during storage period. On the second day distilled water dipping for 5 min showed higher (11.81%) physiological weight loss followed by precooling at 100C for 10 min (9.95%). Minimum loss was recorded with KMS @ 100ppm (7.45%) followed by oxalic acid @ 10%. Similarly on the fourth day of storage maximum physiological weight loss was recorded with control (18.77%) followed by distilled water dipping for 5 min (18.66%) and minimum loss was recorded with oxalic acid @ 10% (13.39%). On the sixth day of storage more or less similar result was found as on fourth day of storage but in increasing pattern. Similarly on the eighth and tenth day of storage control showed maximum PLW while oxalic acid @ 10% resulted in minimum physiological weight loss of litchi fruit. More or less similar result was obtained in the second year of experiment 2015 too.

This finding was in line with report of Pandey and Lal (2014) who said that physiological weight loss was also reduced to minimum (3.72%) in fruits treated with oxalic acid (10%). Similar view was expressed earlier by Dhua et al.,(1995) who reported that HCl+KMS treatments minimize physiological weight loss of litchi fruit. The effect in minimizing the PLW of litchi fruit with the applied chemicals might be due to their ability in retaining more water against the force of evaporation and possibly their affinity for water is increased.

Spoilage Loss

Data with respect to the influence of post harvest treatments on spoilage loss of litchi fruit is presented in Table 3. From the perusal of data of 2014, a significant variation regarding the spoilage loss was noticed with different post harvest treatments, as the storage period was prolonged from 2-10 days after treatments. On the second day of storage no spoilage loss was recorded. On the fourth day of storage minimum loss was recorded with oxalic acid @ 10% (3.00%) and maximum loss was recorded with precooling + KMS @ 100ppm (11.33%) followed by control (8.00%). On the sixth day of storage minimum loss was recorded with oxalic acid @ 10% (8.00%) and maximum loss was recorded with precooling + KMS @ 100ppm (19.33%) followed by control (15.67%). On the eighth day of storage maximum loss was recorded with control and minimum loss with oxalic acid @ 10%. On the tenth day of storage minimum loss was recorded with oxalic acid @ 10% followed by KMS @ 100ppm and maximum loss was recorded with control (77.67%). Similar result was experienced in 2015 also.

This finding is in line with results obtained by Pandey & Lal (2014) who reported that spoilage loss of (10.14) % in fruit treated with oxalic acid @ 10%. Dhua et.al. (1995) reported reduction in spoilage loss of litchi fruit after chemical treatments using KMS and HCl in various concentrations. Shrestha (2002) reported that the chemicals having the antirespirant and antisenescent effect lowers the physiological activities reduce the loss of water during storage. As a consequence, fruit remain in better and normal condition during storage.

Conclusion

The retention of marketable and acceptable colour varied with different treatments. Further, the use of oxalic acid @ 10% was found superior in both years. Among the treatments, oxalic acid @ 10% was quite effective to minimize the physiological loss in weight of litchi fruit. This treatment could reduce the PLW of litchi fruit by 11.62% as compared to control on final day of storage in the first year while in the second year this treatment reduced the PLW by 7.26% as compared to control. Besides, all the chemicals were capable in reducing the PLW as compared to control. The spoilage loss was lower with oxalic acid @ 10% on final day of storage by 37% as compared to control in the 1st year. But in the second year, minimum loss was recorded with KMS @ 75ppm by 22.6% as compared to control.

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Table 2. Physiological loss in weight of litchi fruit under different post harvest treatment at ordinary room temperature, 2014 and 2015

Treatments	Physiological loss in weight (%) on days indicated									
	2		4		6		8		10	
	2014	2015	2014	2015	2014	2015	2014	2015	2014	2015
Control	9.01bcd	11.82	18.77a	19.70a	29.28a	28.60a	39.49a	32.96a	52.25a	37.65a
Distilled water dipping	11.81a	11.58	18.66a	18.33ab	28.76a	23.33b	38.21a	30.22bc	49.70a	34.93abc
Pre cooling at 100C for 10min	9.95b	11.28	16.21b	16.44b	25.02b	22.96b	34.43b	30.40abc	46.48b	33.42bc
Precooling + KMS @75ppm	9.75bc	11.32	16.28b	16.35b	25.20b	22.42b	34.60b	28.27c	46.40b	32.61cd
Precooling + KMS @100ppm	8.57bcd	11.56	15.34bc	17.48ab	23.81bc	23.93b	33.07bc	31.66ab	44.18b	34.00bc
KMS @ 75ppm	8.17bcd	9.67	14.72cd	12.20c	23.27c	22.96b	32.71cd	29.67bc	44.94b	34.74abc
KMS @ 100ppm	7.45d	11.87	15.49bc	17.18ab	24.11bc	27.41a	33.22bc	31.20ab	46.12b	36.39ab
Oxalic acid @ 10%	8.08cd	11.74	13.39d	13.12c	20.65d	20.57c	31.18d	28.34c	40.63c	30.39d
LSD (5%)	1.654	NS	1.335	2.82	1.524	1.642	1.568	2.434	2.692	2.79
SEM±	0.552	0.895	0.445	0.941	0.508	0.548	0.523	0.812	0.898	0.934
CV	10.5	13.6	4.8	10	3.5	3.9	2.6	4.6	3.4	4.7

Means within the column followed by same letter do not differ significantly at 5% level by DMRT.

Table 3. Spoilage loss (%) of litchi fruit under different post harvest treatment at ordinary room temperature, 2014 and 2015

Treatments	Spoilage loss (%) on days indicated									
	2		4		6		8		10	
	2014	2015	2014	2015	2014	2015	2014	2015	2014	2015
Control	0.00	0.00	8.00ab	9.33a	15.67ab	19.33a	42.00a	46.00a	77.67a	69.3a
Distilled water dipping	0.00	0.00	6.67bc	6.67b	13.67bc	21.33a	33.33b	38.7ab	65.00c	63.0ab
Pre cooling at 100C for 10 min	0.00	0.00	2.67c	4.67bc	8.67d	19.33a	23.67c	36.7ab	48.67ef	53.0bc
Precooling + KMS @ 75ppm	0.00	0.00	2.67c	6.00bc	9.33cd	18.00ab	26.67bc	36.7ab	47.00f	59.3abc
Precooling + KMS @100ppm	0.00	0.00	11.33a	4.67bc	19.33a	19.67a	35.00ab	46.3a	70.00b	56.0bc
KMS @ 75ppm	0.00	0.00	3.00c	4.67bc	12.33bcd	14.00c	24.00c	30.0b	52.33d	46.7c
KMS @ 100ppm	0.00	0.00	5.33bc	5.33bc	14.00bc	15.33bc	28.67bc	35.3ab	52.00de	58.0abc
Oxalic acid @ 10%	0.00	0.00	3.00c	3.33c	8.00d	12.00c	22.67c	27.3b	40.67g	51.3bc
LSD (5%)	0.00	0.00	3.99	2.54	4.62	3.277	8.065	12.79	3.426	11.92
SEM±	0.00	0.00	1.33	0.85	1.541	1.093	2.69	4.27	1.143	3.98
CV	0.00	0.00	43.3	26.4	21.1	10.9	15.8	19.9	3.5	12.1

Means within the column followed by same letter do not differ significantly at 5% level by DMRT.

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