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RESPONSE OF POST HARVEST TREATMENTS ON NUTRITIONAL CHARACTERISTICS AND SHELF LIFE OF LITCHI (cv. DEHRADUN)

MONICA RESHI*, RAJ KUMARI KAUL, ANJU BHAT AND SATISH K. SHARMA[1]
Division of Food Technology, SKUAST-J, Chatha, Jammu - 180 009
[1]School of Biotechnology, FOA SKUAST-J, Chatha, Jammu - 180 009
e-mail:-monika.reshi@gmail.com

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***Corresponding author**

ABSTRACT
Cultivar performance of litchi (Litchi chinensis Sonn.) and roles of water loss, browning and calcium in post harvest fruit senescence were studied; different combinations of post harvest treatments applied showed a great influence in retaining the nutritional characteristics which reduce the wastage of fresh fruits. Storage studies revealed that over a period of 10 days at (32+ 3°C), a continuous and significant decline in physiological loss in weight from 1.33% to 5.08%, acidity (0.41% to 0.22%) and ascorbic acid (42.64 to 25.71mg/100m1) was recorded, whereas, a gradual increase in TSS from 20.17 Brix to 26.64Brix (up to 6 days) and then decrease to 17.06 Brix (upto 10 days). Thus it can be inferred from the study that calcium extends the shelf-life of fruit by maintaining firmness. Minimizing the rate of respiration, disintegration of tissues and disease incidence while as sulphur maintains the colour of the fruit.

INTRODUCTION

Litchi fruit (Litchi chinensis Sonn.) with a bright red pericarp and clear white pulp are preferred in the market and have a high economic value. However, harvested fruit lose water rapidly, causing a breakdown in browning in cellular compartmentalization, leading to enzymatic browning and non enzymatic browning of pericarp (Noktlai *et al*. 2010). Previous studies have reported that 0-5°C, litchi fruit can be stored for a approximately 20-30 days, but at 20°C, can be stored for 2-3 days (Sivakumar *et al*. 2010).

Chemicals like calcium and sulphur compounds have been reported to prolong quality and shelf life of fruits. Calcium compound extends the shelf-life of fruits by maintaining firmness, minimizing the rate of respiration, disintegration of tissues and Disease incidence (Sivakumar and Korsten 2006). On the other hand sulphuring has a fungicide effect and ensures fixing of the red colouration of the pericarp and prevents brittleness during storage and transportation (Normand and Bouffin 1995). A possible combination between sulphur fumigation and calcium nitrate dips control browning as well as rotting and simultaneously enhances shelf-life. Keeping in view the present study was an attempt to increase the shelf life period and maintain the quality of litchi fruit.

MATERIALS AND METHODS

Freshly harvested litchi fruits (cv. Dehradun) of uniform maturity, size and colour were selected for the study. The fruits were divided into nine different lots and each lot was separately subjected to sulphur fumigation, calcium nitrate dipping and to their Combinations as per the details of treatments shown in Table 1. Out of nine lots one lot was simply dipped in water as control for making comparative assessment.

In sulphur fumigation the fruits were spreaded on different wooden trays having round holes of density l kg/fee and were staked one above the other. The staked trays were covered with a box to make it air tight and fumigation was carried out by burning chemically pure sulphur @ 0.6 and 0.7g/kg of fruits separately in an iron bowl for one hour. For calcium nitrate treatment the fruits were dipped separately in 1.5 and 2.0 percent calcium nitrate solution for 30minutes.

Both sulphur fumigated fruits as well as calcium nitrate dipped fruits were again subjected to different combination treatments with each other as per the Table 1. The treated fruits were air dried properly and packed in polythene bags (0.6 per cent perforation) for further storage at room temperature i.e. 32+ 3"C. Observations we rerecorded for red colour development, physiological loss in weight and anthocyanin content. The biochemical constituents like TSS, titratable acidity, sugars both total and reducing and ascorbic acid were estimated (AOAC 1995, Rangana 1986 and Zheng and Tian 2006).

T_1 Sulphur fumigation @0.6g/kg of fruit
T_2 Sulphur fumigation @ 0.7g/kg of fruit
T_3 Calcium nitrate dips l.5%/kg of fruit
T_4 Calcium nitrate dips 2%/kg of fruit
T_5 Sulphur fumigation @ 0.6g/kg of fruit + Calcium nitrate dips 1.5%//kg of fruit
T_6 Sulphur fumigation @ 0.6g/kg of fruit + Calcium nitrate dips 2%/kg of fruit
T_7 Sulphur fumigation @ 0.7g/kg of fruit +Calcium nitrate

dips I .5%/kg of fruit

T_8 Sulphur fumigation @ 0.7g/kg of fruit + Calcium nitrate dips 2%/kg of fruit

T_9 Control

RESULTS AND DISCUSSION

In the study, the data present in Table 1 revealed that the PLW of fruits increased with the increase in duration of storage irrespective of treatments. It was evident from the table that after 6days of storage the highest PLW (3.63%) was recorded in T_9 and the lower of 1.93 percent in T_3. After 10 days of storage T_9 registered the maximum physiological loss in Weight (6.80%) followed by T_7 and T_5 having values as 5.43 and 5.33 per cent, respectively and the minimum PLW of 4.10 per cent was recorded in T_3 The PLW of rest of the treatments was within the range of 5.00 and 4.90 per cent. The increase in Physiological loss in weight might be due to evaporation and transpiration processes. Calcium extends the shelf-life of fruit by maintaining their firmness and minimizing respiration rate, proteolysis and tissue breakdown. It also acts as an anti-senescence agent by preventing cellular disorganization by maintaining protein and nucleic acid synthesis (Narayana *et al*.2002). This increase in physiological loss in weight during storage period was also reported by Singh and Manda, 2000 and Chakraborty and Banik, 2003 in litchi fruit. There was an increase in TSS content in litchi fruit initially in all the treatments (Table 2) and then a continuous decreasing trend was observed upto the last day of storage. The effect of treatments over entire storage period was found to be statistically significant having highest mean value of 21.70° brix in case of T_3 which was followed byT_7, T8 and T_6. The lowest value of 17.98° brix was obtained in case of T_9. Decrease in TSS was most likely due to decline in aril's sucrose content and this was mainly because the pace of degredative changes leads to senescence; breakdown of carbohydrate polymers, which occur with the advancement of fruit age during storage. After 6 days of shelf life the highest acidity (Table 3) of 0.40 per cent was recorded in T_9 which was closely followed by T_1 and T_7 having values as 0.37 and 0.32 per cent respectively, whereas T_3 registered the lowest acidity of 0.25 per cent. The final schedule of analysis revealed that T_9 recorded the highest acidity of 0.39 per cent. Gradual and progressive decrease in acidity was observed under all the treatments during storage and this progressive decline might be due to utilization of acid in metabolism. This decrease in acidity was in conformity with the findings of Ray *et al*., (11). A perusal of data in Table 4 depicted a significant increase in reducing sugars so far storage is concerned. During storage the mean reducing sugar content increased initially from 7.83 to 9.15 per cent up to 6 days of storage and afterwards a decrease was noticed up to last day or storage. The data pertaining to the mean values of total Sugar obtained by different treatments (Table 5) showed that after 6 days of storage, T_3, had the highest sugar content 17.48 per cent. Similar results were obtained after 10 days of storage. Decrease in reducing and total sugar was most likely due to decline in aril's sucrose content. Rapid deterioration in sugars at ambient temperature has also been reported. This was mainly because the pace of degenerative changes leading to senescence that occurs with advancement of fruit age during storage. The increase in sugars was in conformity with the findings of Ray *et al.,* 2005. The data in Table 6 pertaining to ascorbic acid content of different treatments revealed thin after 6 days of storage, the maximum ascorbic acid content of 38.72mg/ 100ml was found in T_9 and the minimum of 36.06mg/100ml it T_8. In second phase alter 10 days of shelf life, the maximum

Table 1: Effect of different treatments on per cent physiological loss in weight (PLW) of litchi cv. Dehradun at ambient condition

Treatment	Storage period (days)					
	2	4	6	8	10	Mean
T_1	0.90	1.36	2.03	3.03	4.46	2.3.6
T_2	1.00	1.36	2.10	3.10	4.48	2.48
T_3	0.60	1.13	1.93	2.87	4.10	2.12
T_4	2.10	2.56	2.83	3.03	4.90	3.20
T_5	1.40	2.03	2.70	3.67	5.33	3.02
T_6	1.80	2.33	2.73	3.80	4.80	3.10
T_7	0.80	1.46	2.27	3.40	5.43	2.68
T_8	1.26	1.83	2.70	3.30	5.00	2.81
T_9	2.13	3.13	3.63	4.40	6.80	4.02
Mean	1.33	1.91	2.55	3.45	5.08	

Effect	Sem (±)	CD (p=0.0)
Treatment	0.07	0.20
Storage period (days)	0.05	0.15
Treatment × storage period (days)	0.16	0.47

Table 2: Effect of different treatments on total soluble solid (B) of litchi cv. Dehradun at ambient condition

Treatment	Storage period (days)					
	2	4	6	8	10	Mean
T_1	19.97	20.67	20.63	20.09	19.47	20.17
T_2	20.91	21.20	20.79	19.73	19.50	20.42
T_3	20.97	22.36	22.00	21.70	21.60	21.70
T_4	18.63	19.67	19.40	19.10	19.03	19.16
T_5	20.77	21.17	20.27	20.17	19.13	20.30
T_6	20.57	21.60	21.33	21.30	20.29	21.01
T_7	20.93	21.77	21.40	21.33	21.13	21.31
T_8	20.89	21.67	21.37	21.07	20.43	21.08
T_9	17.95	18.53	18.62	17.78	17.06	17.98
Mean	20.17	20.94	20.64	20.25	19.73	

Effect	CD (p=0.05)
Treatment	0.73
Storage period (days)	0.54
Treatment × storage period (days)	NS

Table 3: Effect of different treatments on titrability acidity (%) of litchi cv. Dehradun at ambient condition

Treatment	Storage period (days)					
	2	4	6	8	10	Mean
T_1	0.46	0.43	0.37	0.30	0.22	0.36
T_2	0.44	0.35	0.29	0.18	0.23	0.31
T_3	0.35	0.30	0.25	0.22	0.18	0.26
T_4	0.42	0.36	0.30	0.26	0.21	0.31
T_5	0.42	0.33	0.29	0.24	0.19	0.29
T_6	0.40	0.32	0.27	0.23	0.21	0.28
T_7	0.46	0.37	0.32	0.26	0.26	0.31
T_8	0.38	0.33	0.29	0.25	0.20	0.29
T_9	0.48	0.45	0.40	0.36	0.32	0.39
Mean	0.41	0.36	0.30	0.26	0.22	

Effect	CD (p=0.05)
Treatment	0.01
Storage period (days)	0.01
Treatment x storage period (days)	0.02

*Initial value of total soluble solid (at harvest) = 0.50%

Table 4: Effect of different treatments on reducing sugars (%) of litchi cv. Dehradun at ambient conditions

Treatment	Storage period (days)					
	2	4	6	8	10	Mean
T_1	7.35	7.79	8.38	7.35	6.77	7.53
T_2	8.73	9.26	9.36	8.46	8.08	8.78
T_3	8.86	9.96	10.42	8.64	7.14	8.94
T_4	8.25	9.86	9.30	8.70	7.93	8.80
T_5	7.14	7.70	8.73	7.20	6.44	7.44
T_6	7.30	7.84	8.33	7.63	6.51	7.52
T_7	8.16	9.74	11.01	8.13	7.26	8.86
T_8	7.31	7.78	8.37	7.48	6.44	7.47
T_9	7.38	7.80	8.49	6.99	5.37	7.41
Mean	7.83	8.63	9.15	7.84	6.99	

Effect	CD (p = 0.05)
Treatment	0.70
Storage period (days)	0.52
Treatment × storage period (days)	NS

*Initial value of total soluble solid (at harvest) = 6.82 %

Table 5: Effect of different treatments on total sugars (%) of litchi cv. Dehradun at ambient condition

Treatment	Storage period (days)					
	2	4	6	8	10	Mean
T_1	14.53	14.90	15.44	14.07	12.25	14.28
T_2	14.95	15.34	16.04	14.19	11.84	14.47
T_3	15.57	16.21	17.48	15.41	14.10	15.75
T_4	14.49	15.07	15.74	14.99	13.89	14.83
T_5	14.99	15.72	16.02	15.19	13.91	15.16
T_6	13.87	14.97	16.21	15.00	13.93	14.69
T_7	15.07	16.16	16.82	14.90	13.33	15.23
T_8	14.04	15.34	16.11	14.33	13.49	14.66
T_9	14, 25	14.50	13.20	13.19	11.15	13.28
Mean	14.54	15.34	16.01	14.58	13.04	

Effect	CD (p = 0.05)
Treatment	0.33
Storage period (days)	0.24
Treatment × storage period (days)	0.74

*Initial value of total soluble solid (at harvest) = 12.12 %

Table 6: Effect of different treatments on ascorbic acid (%) of litchi cv. Dehradun at ambient condition

Treatment	Storage period (days)					
	2	4	6	8	10	Mean
T_1	43.08	37.44	36.20	29.72	26.12	34.51
T_2	43.09	37.41	36.16	29.22	26.05	34.39
T_3	43.17	38.76	37.37	30.82	27.13	35.44
T_4	42.03	38.14	37.06	30.40	27.37	35.00
T_5	43.16	38.84	37.34	30.42	27.20	35.30
T_6	40.02	37.89	36.42	29.13	26.17	33.92
T_7	43.14	37.80	36.14	29.22	26.18	34.49
T_8	43.10	37.30	36.06	29.30	26.40	34.43
T_9	42.95	37.23	38.72	25.92	18.75	32.71
Mean	42.64	37.87	35.71	29.35	25.71	

Effect	CD (p = 0.05)
Treatment	0.37
Storage period (days)	0.28
Treatment x storage period (days)	0.84

*Initial value of total soluble solid (at harvest) = 48.02mg/100ml

Table 7: Effect of different treatments on anthocyanian content (mg/100ml) of litchi cv. Dehradun at ambient condition

Treatment	Storage period (days)					
	2	4	6	8	10	Mean
T_1	52.23	64.23	60.33	58.46	54.33	58.12
T_2	46.16	54.20	56.16	54.13	49.96	52.12
T_3	50.13	52.60	40.10	37.40	32.23	42.49
T_4	50.10	52.33	42.23	39.10	37.10	44.19
T_5	49.96	64.13	49.16	40.03	37.20	48.10
T_6	54.13	60.36	50.40	38.23	36.00	47.82
T_7	51.20	65.33	46.13	43.96	39.60	49.24
T_8	50.33	58.43	56.60	50.13	47.90	52.68
T_9	39.90	34.23	26.63	-	-	20.17
Mean	49.98	59.68	47.55	40.16	37.14	

Effect	CD (p = 0.05)
Treatment	0.01
Storage period (days)	0.01
Treatment x storage period (days)	0.02

*Initial value of total soluble solid (at harvest) = 0.50%

ascorbic acid content 27.37mg/100ml was recorded T_4 and the minimum of 18.75mg/100ml by T_9, and on comparing the treatments with each other on the basis of mean values, it was observed that T_3, recorded the highest value of 35.44mg/100ml and was significantly different from the rest of the treatments. The present investigation revealed that calcium dips prevents the loss of ascorbic acid. The decreasing trend in ascorbic acid has also been reported by Mahajan *et al.*, 2003 and Ray *et al.*, 2005. The mean values of anthocyanin content obtained by different treatments shown in Table 7 revealed that after 6 days of storage the anthocyanin decreases but the highest anthocyanin content of 60.33mg/100ml followed by T_8, T_2, T_6, T_5, T_4 and T_3, having values as 56.60, 56.16, 50.40, 49.16, 42.33 and 40.10mg/100ml respectively and lowest were recorded in T_9, as 26.63mg/100ml. As far as the overall effects of treatments were concerned, T_1, recorded the highest mean value of 58.12mg/100m1. While as T_9, registered the lowest of 20.17mg/100m1 of anthocyanin. This might be due to the release of SO_2 from fumigation and inhibiting the activity of polyphenol oxidase with other enzymes of the fruit pericarp and the pigments remain in their glucose form, thus retaining the colour and quality of fruit. These findings are in with the findings of Mahajan *et al.*, 2003.

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