

## Effects of Harvest Time on Physicochemical Attributes of Papaya cv. Red Lady under Storage

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### Authors' contributions

This work was carried out in collaboration between all authors. All authors read and approved the final manuscript.

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### ABSTRACT

Papaya (*Carica papaya* L.) is the most important nutritious fruit crop of the tropical and subtropical region, belongs to the caricaceae family. In this study, the main objective was to evaluate the effects of harvest time on fruit quality attributes. For this papaya fruit cv. Red Lady was harvested at three different times during 7 A.M., 12 P.M., and 5 P.M. then it brings to the laboratory for evaluation. In this present study different physicochemical parameters viz. TSS, Acidity, TSS-Acidity ratio, physiological loss in weight (PLW), firmness of fruit and fruit volume were evaluated at 0 and 3 days interval up to the 9<sup>th</sup> days of storage. The results from pooled data showed that the TSS content ranged from 8.48 to 9.95 °Brix, acidity content from 0.25 to 0.29%, TSS-Acidity ratio from 30.27 to 38.25, PLW from 15.12 to 19.81% and fruit volume from 517 to 822 ml at 9<sup>th</sup> day of storage. The firmness of the fruit maintained higher (7.20 kg/cm<sup>2</sup>) at 5 P.M. harvested fruit which is at par (7.13 kg/cm<sup>2</sup>) with 7 A.M. harvested fruit and lowest (4.88 kg/cm<sup>2</sup>) at 12 P.M. harvested fruit. Among the three different harvesting time, fruit harvested at 7 A.M., and 5 P.M. showed overall good results in maintaining quality attributes. Whereas, fruits of 12 P.M. results in higher rate of physiological loss in weight of fruit than others.

**Keywords:** Papaya; quality; harvest time; fertiliser; postharvest.

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## 1. INTRODUCTION

Papaya (*Carica papaya* L.) originated in tropical America and is a widely grown fruit crop of the tropical and subtropical region. These are grown as backyard as well as at commercial level due to dwarfing nature. It belongs to the family Caricaceae with chromosome numbers of  $2n = 2X = 18$ . They grow well under a temperature range of 21 to 33°C with well-distributed rainfall of 110-120 cm in the entire growth period. Growth and yield of papaya mainly influenced by various environmental factors like light, temperature, rainfall, nutrient status of soil and other soil properties [1].

Nowadays, papaya cv. Red Lady has gained maximum popularity due to gynodioecious nature and its easy cultivation, quick return with good yield and quality fruits. It starts bearing fruit at a height of 75-85 cm with 20-25 numbers of fruit per plants in each fruiting season. Fruits are the rich source of vitamin A content along with several other nutritive quality.

There are changes in physiological and metabolic activity in fruit just after harvest. Inappropriate harvesting and management practices together with high temperature may affect the postharvest quality and shelf life of fruits. That results in losses of its market value and consumer preference within a short period of time. According to Paull et al. [2], correctly harvested papaya have the shelf life of 4-6 days at 25-28°C while it is 3 weeks at 10-12°C. Papaya is highly nutritious fruit eaten raw as well as after ripening. It is good for peoples of all category due to its medicinal and antioxidant properties. Therefore, harvesting of fruit at the appropriate time is necessary.

## 2. MATERIALS AND METHODS

This experiment was undertaken in the Department of Horticulture (Fruit & Fruit Technology), Bihar Agricultural College, Bihar Agricultural University, Sabour, Bhagalpur, Bihar during 2016-17 and 2017-18. The experiment consisted of three level of each nitrogen and potash with three replication under Randomized Block Design.

Sabour is located at a distance of about 10 km east of Bhagalpur town in the state of Bihar, India. It is situated between 25.15' 40" North latitude, 87.20' 42" east longitude and at a vast altitude of 45.72 meters above the mean sea

level. The soils are alluvial having pH value of 6.8 with low nitrogen, phosphorus, and potassium with good drainage facility. Field is well ploughed and finely prepared with pit size of 45cm x 45 cm x 45cm and then FYM is applied in the pit. Planting is done at a spacing of 2m x 2m during the last week of May. Uniform basal doses of phosphorus @ 100 g per plant are given. Alone and in the combination of nitrogen and potash are applied at three levels of 0g, 100g, 200g and 0, 200 and 400 g respectively per plant. Fertilizer was placed 15-20 cm away from the plant in ring basin and mixed properly in the soil. Fruits from best treatment (based on weight and number of fruits per plant) are harvested at colour break stage (appearance of 15-20% yellow colour) at three different times of the day (7 A.M., 12P.M. and 5 P.M ) and brought to the laboratory for postharvest analysis of physical and quality attributes.

## 3. RESULTS AND DISCUSSION

### 3.1 Results

In this study, it is observed that fruit volume and firmness of the fruit decreases with the advancement of storage period. Data among different harvest time ranged from 517 to 822 ml and 4.88 to 7.20 kg/cm<sup>2</sup> respectively at the 9<sup>th</sup> days of storage. Whereas the physiological loss in weight (PLW) increases with an increase in the storage period and data ranged from 15.12 to 19.81% (Table 1).

From the Table 2, it was also observed that total soluble solids content among fruits of different harvesting time varies between 8.53 - 9.95 °Brix, acidity from 0.25 - 0.29 % and TSS-acidity ratio from 30.27 - 38.25 in papaya cv. Red Lady during storage under ambient condition up to nine days.

### 3.2 Discussion

Physical parameters like fruit firmness (kg/cm<sup>2</sup>), fruit volume (ml) and physiological loss in weight (%) were found differ significantly among the different harvest time under uniform fertilizer application in all the papaya plant. Fruit firmness is the most important distinguishing character to know constancy or solidity of fruit which is essential for shelf life and crunchiness of fruit. However, firmness of fruit also depends on cell wall composition and its structure. Cell wall mainly consists of calcium pectate i.e.

**Table 1. Effects of harvest time on physical parameters of papaya fruit cv. red lady during storage at ambient condition**

Treatment	Firmness (kg/cm <sup>2</sup> )				PLW (%)				Fruit volume (ml)			
	0 day	3 <sup>rd</sup> day	6 <sup>th</sup> day	9 <sup>th</sup> day	0 day	3 <sup>rd</sup> day	6 <sup>th</sup> day	9 <sup>th</sup> day	0 day	3 <sup>rd</sup> day	6 <sup>th</sup> day	9 <sup>th</sup> day
N <sub>0</sub> C <sub>2</sub> M <sub>0</sub> , 7A.M.	14.75	11.00	9.63	6.43	0	10.56	12.37	17.61	747.50	703.75	680.00	652.50
N <sub>0</sub> C <sub>2</sub> M <sub>1</sub> , 7A.M.	15.38	11.63	8.00	6.25	0	8.24	9.42	16.18	811.25	768.75	725.00	687.50
N <sub>0</sub> C <sub>2</sub> M <sub>2</sub> , 7A.M.	16.75	12.63	8.38	6.68	0	8.66	9.85	15.76	953.25	857.50	796.25	721.25
N <sub>1</sub> C <sub>2</sub> M <sub>2</sub> , 7A.M.	13.75	10.88	6.05	5.58	0	8.36	9.64	15.47	932.50	875.00	825.00	771.25
N <sub>2</sub> C <sub>1</sub> M <sub>1</sub> , 7A.M.	12.25	9.25	8.88	7.13	0	8.08	8.51	15.12	907.50	835.00	777.50	742.50
N <sub>0</sub> C <sub>2</sub> M <sub>0</sub> , 12 P.M.	13.75	10.63	8.38	5.50	0	10.50	13.49	19.20	690.00	615.00	561.25	517.50
N <sub>0</sub> C <sub>2</sub> M <sub>1</sub> , 12 P.M.	12.50	11.75	7.43	5.25	0	8.69	12.72	19.74	796.25	732.50	675.00	635.00
N <sub>0</sub> C <sub>2</sub> M <sub>2</sub> , 12 P.M.	12.50	8.25	6.38	5.38	0	9.37	15.27	19.81	855.00	795.00	750.00	682.50
N <sub>1</sub> C <sub>2</sub> M <sub>2</sub> , 12 P.M.	14.13	9.50	7.13	4.88	0	9.57	12.51	18.53	780.00	747.50	692.50	655.00
N <sub>2</sub> C <sub>1</sub> M <sub>1</sub> , 12 P.M.	13.50	9.50	8.38	6.13	0	8.78	14.68	17.02	1007.50	915.00	882.50	816.25
N <sub>0</sub> C <sub>2</sub> M <sub>0</sub> , 5 P.M.	15.00	10.00	6.30	5.58	0	10.18	15.43	18.72	1015.00	965.00	906.25	822.50
N <sub>0</sub> C <sub>2</sub> M <sub>1</sub> , 5 P.M.	14.25	9.25	6.75	5.20	0	8.77	13.60	17.50	782.50	722.50	663.75	610.00
N <sub>0</sub> C <sub>2</sub> M <sub>2</sub> , 5 P.M.	15.00	8.33	8.33	7.20	0	8.36	13.22	18.28	805.00	745.00	695.00	622.50
N <sub>1</sub> C <sub>2</sub> M <sub>2</sub> , 5 P.M.	13.88	7.80	7.30	6.20	0	8.02	15.84	18.13	765.00	695.00	653.75	608.75
N <sub>2</sub> C <sub>1</sub> M <sub>1</sub> , 5 P.M.	15.25	10.13	8.50	7.13	0	9.85	15.67	17.58	765.00	712.50	625.00	580.00
SE(m)±	0.8234	0.4865	0.4448	0.3600	0	0.2627	0.2241	0.3612	32.1708	35.8174	44.8002	51.2173
C.D. @ 5%	1.7660	0.9818	0.8976	0.7266	0	0.5301	0.4523	0.7289	68.9996	76.8207	96.0868	109.8502

N<sub>0</sub>=0g neem coated urea, N<sub>1</sub>= 100g neem coated urea, N<sub>2</sub>=200g neem coated urea C<sub>1</sub>= 100g calcium nitrate, C<sub>2</sub>= 200g calcium nitrate, M<sub>0</sub>= 0g murate of potash, M<sub>1</sub>= 200g murate of potash, M<sub>2</sub>= 400g murate of potash

**Table 2. Effects of harvest time on quality parameters of papaya fruit cv. red lady during storage at ambient condition**

Treatment	TSS (°Brix)				Acidity (%)				TSS-Acidity ratio			
	0 day	3 <sup>rd</sup> day	6 <sup>th</sup> day	9 <sup>th</sup> day	0 day	3 <sup>rd</sup> day	6 <sup>th</sup> day	9 <sup>th</sup> day	0 day	3 <sup>rd</sup> day	6 <sup>th</sup> day	9 <sup>th</sup> day
N <sub>0</sub> C <sub>2</sub> M <sub>0</sub> , 7A.M.	5.82	7.35	8.15	8.48	0.35	0.32	0.29	0.27	16.40	23.31	27.90	32.23
N <sub>0</sub> C <sub>2</sub> M <sub>1</sub> , 7A.M.	6.20	7.28	8.00	8.53	0.41	0.36	0.30	0.27	15.61	20.44	26.90	31.14
N <sub>0</sub> C <sub>2</sub> M <sub>2</sub> , 7A.M.	6.10	7.75	8.13	8.80	0.38	0.34	0.31	0.26	16.47	23.15	26.26	33.69
N <sub>1</sub> C <sub>2</sub> M <sub>2</sub> , 7A.M.	6.35	8.08	8.53	9.20	0.39	0.33	0.32	0.29	16.68	24.64	26.78	31.78
N <sub>2</sub> C <sub>1</sub> M <sub>1</sub> , 7A.M.	5.83	7.65	8.18	8.70	0.40	0.32	0.31	0.29	15.15	24.08	26.53	30.52
N <sub>0</sub> C <sub>2</sub> M <sub>0</sub> , 12 P.M.	6.03	7.88	8.53	9.95	0.40	0.33	0.32	0.29	15.80	23.61	26.43	33.82
N <sub>0</sub> C <sub>2</sub> M <sub>1</sub> , 12 P.M.	5.10	7.40	8.88	9.78	0.39	0.32	0.27	0.26	13.58	22.80	32.34	38.25
N <sub>0</sub> C <sub>2</sub> M <sub>2</sub> , 12 P.M.	5.30	7.30	8.05	9.83	0.36	0.32	0.28	0.28	14.94	22.87	28.57	35.53
N <sub>1</sub> C <sub>2</sub> M <sub>2</sub> , 12 P.M.	5.63	7.13	8.30	9.05	0.42	0.35	0.30	0.28	13.30	20.38	27.79	32.76
N <sub>2</sub> C <sub>1</sub> M <sub>1</sub> , 12 P.M.	5.10	7.45	7.65	8.58	0.34	0.33	0.32	0.28	15.06	22.93	24.28	30.27
N <sub>0</sub> C <sub>2</sub> M <sub>0</sub> , 5 P.M.	5.25	7.85	8.43	9.10	0.35	0.32	0.31	0.28	15.24	24.58	26.99	32.10
N <sub>0</sub> C <sub>2</sub> M <sub>1</sub> , 5 P.M.	5.78	7.98	8.70	9.48	0.31	0.29	0.28	0.25	18.71	27.50	31.19	38.17
N <sub>0</sub> C <sub>2</sub> M <sub>2</sub> , 5 P.M.	5.65	7.50	8.28	9.60	0.39	0.32	0.30	0.28	14.65	23.51	27.96	34.32
N <sub>1</sub> C <sub>2</sub> M <sub>2</sub> , 5 P.M.	5.70	7.00	7.90	9.03	0.32	0.31	0.29	0.26	17.78	22.40	27.29	35.12
N <sub>2</sub> C <sub>1</sub> M <sub>1</sub> , 5 P.M.	5.85	7.25	8.03	9.10	0.39	0.31	0.29	0.28	15.63	23.63	27.49	32.78
SE(m)±	0.3390	0.1476	0.3218	0.1852	0.0254	0.0186	0.0179	0.0190	1.8726	1.2340	1.7475	2.7392
C.D. @ 5 %	0.6842	0.2979	NS	0.3737	0.0512	NS	NS	NS	NS	2.6467	NS	NS

N<sub>0</sub>=0g neem coated urea, N<sub>1</sub>= 100g neem coated urea, N<sub>2</sub>=200g neem coated urea C<sub>1</sub>= 100g calcium nitrate, C<sub>2</sub>= 200g calcium nitrate, M<sub>0</sub>= 0g murate of potash, M<sub>1</sub>= 200g murate of potash, M<sub>2</sub>= 400g murate of potash

responsible for its stability. It was observed that firmness of fruit decreases as the storage period increases due to loss of turgidity, moisture and the higher rate of respiration. There are also many physiological and biochemical changes like starch to sugar conversion, aroma and volatile flavour synthesis and change in metabolism and cell wall composition, causing firmness loss in fruit [3]. The similar trends were also recorded by Mahajan and Dhatt [4] in Asian pear.

The quality parameters viz. TSS was significant but, acidity and TSS-acidity ratio represented in Table 2. Showed non-significant difference among data due different harvest time. Total soluble solid contents and TSS-acidity ratio increases as the storage period increases. This increase in TSS content is due to loss of moisture content from the fruit and also might be due to inter-conversion of insoluble to soluble segments [5]. The similar trends were recorded by Sandhu et al. [6] in guava leather and in blending ratio of papaya-guava pulp by Jain et al. [7]. The increase in TSS-acidity ratio results due to increase in TSS and decrease in acidity of fruit during storage.

#### 4. CONCLUSION

From, the above research findings it was concluded that there were no significant effects of harvest time on physical parameters but it slightly influence the overall quality of fruits during storage, and fruit harvested at 12 p.m. has the faster rate of weight loss than others.

#### COMPETING INTERESTS

Authors have declared that no competing interests exist.

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