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EFFECT OF DIFFERENT PACKAGING MATERIALS AND GROWTH REGULATORS ON SHELF LIFE AND QUALITY OF PAPAYA (*CARICA PAPAYA* L.) CV. RED LADY

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ABSTRACT

Papaya is one of the most outstanding fruits in India and belongs to family caricaceae now broadly cultivated for profit fruit crop of tropical and subtropical region. The present research work was carried out at college of horticulture during 2018-19. Study the effect of different packaging materials and growth regulators on shelf life and quality of papaya (*Carica papaya* L.) cv. red ladywas stored at room temperature during the investigated. Along with the different packaging materials and growth regulators imposed in the present investigation showed that the total soluble solids content increased from 3rd to 12th day and after that decreasing trend was observed. Maximum total soluble solids recorded in T_1 (9.55^{O}Brix). Maximum ascorbic acid was recorded in fruits treated with T_1 - $CaCl_2$ @ 3.0% and packed with news paper (46.82 mg/100 g pulp). Highest with T_1(9.33%), Reducing sugars were found highest in T_2(7.58%) and where as non reducing sugars were found highest in T_1 - fruits treated with $CaCl_2$ 3.0% and packed with news paper (3.83%). Highest titrable acidity was observed in T_1(0.04%). The storage life was found maximum in T_1 - fruits dipped in $CaCl_2$ @ 3.0% and packed with news paper (17.58 days) and control has shown poor storage life (9.00 days).

Key words : *Carica papaya*, Post harvest management, Shelf life, Growth regulators, Papaya.

Introduction

Papaya fruit has occupied a place of pride in human diet because of its striking nutritional and medicinal values. It is one of the richest source of carotene (pro - vitamin) and a fair source of vitamin C, besides being high in sugars and pectin. Its delicious fruit are not only palatable, nutritive, digestive and also act as a mild laxative. National commission on Agriculture has emphasized that in the present Indian dietary context, there is an urgent need for massive production of "Short duration, less expensive but nutritive fruits" (National commission on Agriculture Report, 1976). Papaya exactly fits in this requirement and becomes an important fruit crop. Papaya fruit has occupied a place of pride in human diet because of its noticeable nutritional and medicinal values, it has short post-harvest life. To increase the shelf-life of Papaya, appropriate post-harvest management is necessary. Investigate efforts have been succeed in increasing the production of papaya fruit, but the main purpose of getting maximum income will not be achieved until the post-harvest losses will be minimized. Papaya has a high level of post harvest loss *viz*. 75-90%, due to its high perishable nature.

Within the same species, different varieties respond differently to post-harvest chemical treatments in extending the shelf life and in hastening the ripening process. In Telangana, the cv. Red Lady has emerged as a leading commercial variety. Hence increasing the shelf life of fruits by using various technologies like post harvest treatments with different chemicals and packaging

materials are important. Keeping this view it is proposed to studies study the effect of different packaging material and growth regulators on shelf life and quality of papaya (*Carica papaya* L.) cv. red lady.

Materials and Methods

Preparation of treatment solutions

Gibberellic acid (GA_3)

100mg, 200mg and 300mg of GA_3 was weighed and dissolved in small amount of ethanol at slight warm state and made upto one liter with distilled water to get 100 ppm, 200ppm and 300ppm solution.

Calcium chloride

Calcium chloride at 1.0 percent, 2.0 percent and 3.0 percent concentrations were prepared by dissolving 50, 100 and 150 of calcium chloride in five liters of distilled water and made the volume of required quantity for application.

The present research was carried out at, Department of Fruit Science, SKLTSHU, Rajendranagar, Hyderabad during 2018-19. The fruits of papaya, which were physiologically mature and have attained the full size, light green with a tinge of yellow at apical end were harvested. The cultivar Red Lady is a Tai - variety developed by Known -You Seed Company. It has replaced all our commercial papaya varieties like CO-2, Coorg Honey Dew and others. It is an early, vigorous, productive variety with long shelf life. Plants of this variety bear fruits at 80cm height on the trunk and normally bear over 30 fruits per plant in each fruit setting season. It is a gynodioecious variety. Fruits are short - oblong on female plants and rather long - oblong shaped on bisexual plants. Flesh is thick, aromatic and red with more than 13 percent sugar. It has good export quality and itis tolerance to papaya ring spot virus. The fruits were washed with water, dipped for 30 seconds in 0.01% Bavistin, dried with muslin cloth and then used for the study. The fruits were selected on the basis of uniformity, maturity, size and shape. The experiment was laid out in completely randomized design (CRD) with 7 treatments and 4 replication.Packaging materials such as news paper and tissues paper (Kimwipes) with size of 40 × 30cm were used for packing of papaya fruits.

The treatments of the investigation comprised of different packaging materials, T_1 - Fruits dipped in $CaCl_2$ 3.0% + News paper, T_2 - Fruits dipped in $CaCl_2$ 3.0% + Tissue paper (Kimwipes), T_3 - Fruits dipped in GA_3 200 ppm + News paper, T_4 - Fruits dipped in GA_3 200 ppm + Tissue paper (Kimwipes), T_5 - Undipped fruits + News paper, T_6 - Undipped fruits+ Tissue paper (Kimwipes), T_7 - Control (No dipped and no pack). The fruits sampled were assessed for Ascorbic acid (mg/100g pulp), Titrable acidity (%), Reducing sugars, Total sugars (%), Non - reducing sugars and Shelf life (days).

Quality parameters

The quality parameters were recorded at ripe stage of papaya fruits.

Total soluble solids (°Brix)

The total soluble solids of the pulp for each treatment was recorded with the help of Hand Refractometer of 0-30 oBrix range and expressed as per cent total soluble solids of the fruit.

Reducing sugars

The titrimetric method of Lane and Eynon estimation of reducing sugar. The method is based on the principle that invert sugar or reducing sugar reduces the copper in the Fehling's solution to red insoluble cuprous oxide.

$$\text{Reducing sugar (\%)} = \frac{\text{Glucose Eq. (0.05)} \times \text{Total volume made up}}{\text{Titre} \times \text{weight of the pulp}} \times 100$$

Total sugars

For estimation of total sugars, the filtrate obtained in the above estimation was used. An aliquot from the filtrate was taken and to one -fifth of its volume, hydrochloride acid (1:1) was added and the inversion was carried out at room temperature for 24 hours. Subsequently, the contents were cooled and neutralized with 40 percentage of sodium hydroxide using phenolphthalein as an indicator and the final volume was made. The solution was filtered through Whatman No. 1 filter paper and titration was carried out using filtrate as detailed for reducing sugars. The total sugar content was expressed as percentage in terms of invert sugars according to the following formula.

$$\text{Total sugars (\%)} = \frac{\text{Fehling's Sol. (0.05)} \times \text{Total Vol. made up} \times \text{Vol. made up after inversion}}{\text{Titre} \times \text{Wt. of sample} \times \text{Aliquot taken for inversion}} \times 100$$

Non-reducing sugars

The percentage of non-reducing sugars was worked out by deducting the percentage of reducing sugars from the percentage of total sugars.

Non-reducing sugars (%) = Total sugars (%) – Reducing sugars (%)

Ascorbic acid (mg/100g of pulp)

Titrimetric method described by Ranganna (1986) was adopted for estimation of ascorbic acid.

The ascorbic acid content was calculated adopting the following formula.

$$\text{Ascorbic acid (mg/100g)} = \frac{\text{Titre} \times \text{Dye factor} \times \text{Vol. made up}}{\text{Wt. of sample} \times \text{Aliquot taken}} \times 100$$

Titratable acidity

The titratable acidity percentage was calculated by adopting the following formula (Eq. wt. of citric acid = 0.064)

$$\text{Acidity (\%)} = \frac{\text{Titre} \times \text{Normality of NaOH} \times \text{Eq. wt. of acid} \times \text{Vol. made up}}{\text{Wt. of sample} \times \text{Aliquot taken}} \times 100$$

Results and Discussion

Ascorbic acid (mg/100g pulp)

The data on ascorbic acid is influenced by combination of different packaging materials and growth regulators on papaya cv. Red lady stored at room temperature is presented in Table 1.

The mean ascorbic acid increased significantly with each successive storage interval from 3rd day (29.02 mg/100g pulp) to 12th day (46.41 mg/100g pulp) there after a decline in ascorbic acid was observed.

Ascorbic acid increased significantly with each successive storage interval from 3rd day to 12th day thereafter a decline trends was observed. Maximum ascorbic acid was recorded in fruits treated with T_1 - $CaCl_2$ @ 3.0 % and packed with news paper (46.09). The maximum value was achieved under the fruits packed in news paper with fruits dipped in $CaCl_2$ @3.0 %. Similar result was reported by Alam *et al.* (2010) in Papaya. The decrease in ascorbic acid content after 12th day it may be due to oxidation of ascorbic acid.

Titrable acidity (%)

The data on titrable acidity is influenced by combination of different packaging materials and growth regulators on papaya cv. Red lady stored at room temperature is presented in Table 2.

Table 1 : Effect of packaging materials and growth regulators on ascorbic acid (mg/100 g pulp) of papaya cv. Red Lady.

Treatments	Ascorbic acid (mg/100 g pulp)					
	3rd day	6th day	9th day	12th day	15th day	18th day
T_1 - Fruits dipped in $CaCl_2$ 3.0 % + News paper	33.32	46.85	50.33	51.20	48.02	46.82
T_2 - Fruits dipped in $CaCl_2$ 3.0 % + Tissue paper	29.31	40.80	43.09	48.17	44.05	37.82
T_3 - Fruits dipped in GA_3 200 ppm + News paper	30.42	42.42	46.42	46.77	40.11	39.49
T_4 - Fruits dipped in GA_3 200 ppm + Tissue paper	27.42	34.81	37.13	42.45	38.30	29.90
T_5 - Undipped fruits + News paper	30.08	38.65	38.63	43.50	-	-
T_6 - Undipped fruits+ Tissue paper	26.14	32.31	33.94	-	-	-
T_7 - Control (No dipped and no pack)	26.43	34.92	40.03	-	-	-
Mean	**29.02**	**38.68**	**41.37**	**46.41**	**42.62**	**38.51**
SEm±	0.24	0.76	0.49			
CD at 5%	0.75	0.23	1.49			

- Fruits spoiled.

Table 2 : Effect of packaging materials and growth regulators on titrable acidity (%) of papaya cv. Red Lady.

Treatments	Titrable acidity (%)					
	3rd day	6th day	9th day	12th day	15th day	18th day
T_1 - Fruits dipped in $CaCl_2$ 3.0 % + News paper	2.55	2.01	0.48	0. 25	0.09	0.04
T_2 - Fruits dipped in $CaCl_2$ 3.0 % + Tissue paper	2.35	1.06	0.33	0.11	0.08	0.01
T_3 - Fruits dipped in GA_3 200 ppm + News paper	2.44	1.92	0.47	0. 14	0.06	0.03
T_4 - Fruits dipped in GA_3 200 ppm + Tissue paper	2.80	1.28	0.31	0.06	0.03	0.02
T_5 - Undipped fruits + News paper	2.61	1.75	0.46	0.03	-	-
T_6 - Undipped fruits+ Tissue paper	2.41	1.27	0.35	-	-	-
T_7 - Control (No dipped and no pack)	2.94	0.95	0.28	-	-	-
Mean	**2.59**	**1.46**	**0.38**	**0.11**	**0.06**	**0.02**
SEm±	0.04	0.05	0.01			
CD at 5%	0.12	0.16	0.03			

- Fruits spoiled.

Table 3 : Effect of packaging materials and growth regulators on reducing sugars (%) of papaya cv. Red Lady.

Treatments	Reducing sugars (%)					
	3rd day	6th day	9th day	12th day	15th day	18th day
T_1 - Fruits dipped in $CaCl_2$ 3.0 % + News paper	6.45	6.55	7.82	8.17	7.55	7.49
T_2 - Fruits dipped in $CaCl_2$ 3.0 % + Tissue paper	5.65	7.17	8.17	9.48	8.45	7.58
T_3 - Fruits dipped in GA_3 200 ppm + News paper	5.62	7.05	8.11	8.62	7.69	7.43
T_4 - Fruits dipped in GA_3 200 ppm + Tissue paper	6.25	7.48	8.28	9.17	8.55	7.37
T_5 - Undipped fruits + News paper	5.42	7.38	8.58	8.98	-	-
T_6 - Undipped fruits+ Tissue paper	5.73	8.18	8.72	-	-	-
T_7 - Control (No dipped and no pack)	5.72	8.33	8.86	-	-	-
Mean	**5.83**	**7.45**	**8.36**	**8.88**	**8.06**	**7.46**
SEm±	0.04	0.05	0.07			
CD at 5%	0.13	0.17	0.22			

- Fruits spoiled

Table 4 : Effect of packaging materials and growth regulators on total sugars (%) of papaya cv. Red Lady.

Treatments	Total sugars (%)					
	3rd day	6th day	9th day	12th day	15th day	18th day
T_1 - Fruits dipped in $CaCl_2$ 3.0 % + News paper	6.92	7.75	9.71	11.60	11.85	11.33
T_2 - Fruits dipped in $CaCl_2$ 3.0 % + Tissue paper	7.35	8.13	10.28	12.25	11.70	9.91
T_3 - Fruits dipped in GA_3 200 ppm + News paper	7.94	8.12	10.11	12.14	11.55	10.75
T_4 - Fruits dipped in GA_3 200 ppm + Tissue paper	7.82	8.65	10.48	9.75	8.85	10.03
T_5 - Undipped fruits + News paper	7.07	8.55	11.84	10.15	-	-
T_6 - Undipped fruits+ Tissue paper	7.14	8.87	12.32	-	-	-
T_7 - Control (No dipped and no pack)	7.95	9.04	12.62	-	-	-
Mean	**7.46**	**8.44**	**11.05**	**11.17**	**10.99**	**10.51**
SEm±	0.52	0.04	0.19			
CD at 5%	0.15	0.14	0.59			

- Fruits spoiled.

The mean titrable acidity decreased significantly with each successive storage interval from 3rd day (2.59%) to 18th day (0.02%). Highest titrable acidity was observed in T_5 – undipped fruits and packed with news paper (1.22%). Lowest acidity was found in T_2- fruits dipped in $CaCl_2$ @ 3.0% and packed with tissue paper (0.66%).

Packaging of papaya fruits in tissue paper showed minimum acidity compare to news paper may be due over ripening at the end of storage in present study is in agreement with the finding of Singh *et al*. (2012) in papaya. The reduction in acidity during storage might be associated with the conversion of organic acids into sugar and their derivatives or their utilization in respiration. Similar results have also been reported by Singh *et al.* (2008) and Sudha *et al.* (2007) in Sapota.

Reducing sugars

The data on reducing sugars is influenced by combination of different packaging materials and growth regulators on papaya cv. Red lady stored at room temperature is presented in Table 3.

The mean reducing sugars increased significantly with each successive storage interval from 3rd day (5.83%) to 12th day (8.88%), and then it was decreased. Reducing sugars were found highest in T_2 (7.58%). The reducing sugars showed progressive increasing trend upto 12th day of storage. There after decline in reducing sugars content was observed. The fruits packed in news paper and dipped in GA_3 @ 200 ppm had shown the maximum reducing sugars, it may be due to increase in sugar during storage may possibly due to break down of complex organic metabolites into sugars. The decline in the sugar content at the later stage of the storage may be attributed to the reason after completion of hydrolysis of starch, no further increase in sugars occurred and subsequently a decline in these parameters is predictable as they along with their organic acids are primary substrate for respiration (Wills *et al*., 1989). Similar results conformity with Kodikara *et al*. (1996) in Papaya.

Table 5 : Effect of packaging materials and growth regulators on non reducing sugars of papaya cv. Red Lady.

Treatments	Non reducing sugars					
	3rd day	6th day	9th day	12th day	15th day	18th day
T_1 - Fruits dipped in $CaCl_2$ 3.0 % + News paper	1.30	1.20	1.89	3.43	4.30	3.83
T_2 - Fruits dipped in $CaCl_2$ 3.0 % + Tissue paper	1.70	0.95	2.11	2.77	3.25	2.33
T_3 - Fruits dipped in GA_3 200 ppm + News paper	1.39	1.07	2.00	3.52	3.86	2.92
T_4 - Fruits dipped in GA_3 200 ppm + Tissue paper	1.57	1.16	2.20	0.58	0.30	2.66
T_5 - Undipped fruits + News paper	1.66	1.17	3.26	1.17	-	-
T_6 - Undipped fruits+ Tissue paper	1.40	0.69	3.60	-	-	-
T_7 - Control (No dipped and no pack)	2.23	0.71	3.75	-	-	-
Mean	**1.61**	**0.99**	**2.69**	**2.29**	**2.93**	**2.94**
SEm±	0.07	0.06	0.17			
CD at 5%	0.21	0.2	0.52			

- Fruits spoiled.

Total sugars (%)

The data on total sugars is influenced by combination of different packaging materials and growth regulators on papaya cv. Red lady stored at room temperature is presented in Table 4. The mean total sugars content was decreased significantly with each successive storage interval from 3rd day (7.46%) to 12th day (11.17%).

The total sugars showed a progressive increasing trend upto 12th days after storage. There after decline in total sugars was observed. The fruits packed in news paper and dipped in $CaCl_2$@ 3.0% had shown the maximum total sugars, it may be due to increase in sugars during storage may possibly due to break down of complex organic metabolites into sugars. The decline in the sugars content at the later stage of the storage may be due attributed to the reason after completion of hydrolysis of starch, no further increase in sugars occurred and subsequently a decline in these parameters is predictable as they along with their organic acids are primary substrate for respiration (Wills *et al.*, 1989). Similar results conformity with Kodikara *et al*. (1996) in papaya.

Non-reducing sugars

The data on non reducing sugars is influenced by combination of different packaging materials and growth regulators on papaya cv. Red lady stored at room temperature is presented in Table 5. The mean non reducing sugars increased significantly with each successive storage interval from 3rd day (1.61) to 9th day (2.69).

The non reducing sugars showed a progressive increasing trend upto 9th days after storage. Thereafter decline in non reducing sugars was observed. The fruits packed in news paper and dipped in $CaCl_2$@ 3.0% had shown the maximum non reducing sugars may possibly due to break down of complex organic metabolites into sugars. The decline in the sugar content after climacteric peak stage of the storage may be attributed to the reason after completion of hydrolysis of starch. A decline in these parameters is predictable as they along with their organic acids are primary substrate for respiration (Wills *et al.*, 1989). Similar results with Kodikara *et al.* (1996) in Papaya.

Shelf life (days)

The post harvest shelf life was found maximum in T_1 - fruits dipped in $CaCl_2$ @ 3.0% and packed with news paper (17.58 days) and followed by T_3- GA_3 @ 100 ppm and packed in news paper (16.25 days). However, control has shown poor shelf life (9.00 days).

Conclusion

Under normal ambient conditions the papaya fruits can be stored up to 8 days without much deterioration, beyond this period the fruits shows very quick spoilage. Study the application of chemicals such as $CaCl_2$ @ 3.0 % had shown beneficial effect on shelf life of papaya fruits and increased shelf life up to 15.32 days without much loss in physico - chemical properties of fruits. Similarly, combination of $CaCl_2$ @ 3.0% and packaging news paper had shown superiority and improved the storage life of papaya fruits up to 17.58 days with good physico - chemical properties as compared to control (9.00 days).

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