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Effect of Different Bio-extracts on Shelf Life and Physical Parameters of Papaya (*Carica papaya* L.) cv. Red Lady

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A B S T R A C T

The research entitled "Effect of different bio-extracts on shelf life and physical parameters of papaya (*Carica papaya* L.) cv. Red Lady" was conducted at College of Horticulture, Rajendranagar, Hyderabad during the year 2019-2020. In the experiment, the design followed was Completely Randomized Design with three replications. The papaya fruits cv. Red Lady were coated with different bio-extracts i.e., T_1: Aloe vera gel extract- 20%, T_2 : Neem leaf extract- 20%, T_3: Garlic extract- 10%, T_4 : Ginger extract- 20%, T_5 : Guar gum -1.5%, T_6 : Acacia gum- 10%, T_7 was taken as control and stored at ambient temperature. Fruits treated with neem leaf extract 20% (T_2) recorded significantly lowest PLW (11.14%), ripening (93.33%), spoilage (42.22%) and significantly highest fruit firmness with peel (1.23 kg/ cm^2) and fruit firmness without peel (0.93 kg/ cm^2) at the end of storage. The highest shelf life (14 days) was observed in fruits treated with neem leaf extract 20% (T_2) followed by garlic extract 10% (T_3) (12.67 days). Hence, the research findings concluded that neem leaf extract 20% (T_2) found to be best in increasing the shelf life and improving the physical parameters of papaya cv. Red Lady fruits at ambient temperature.

Introduction

Papaya (*Carica papaya* L.) belongs to the family Caricaceae, a native fruit of Tropical America, is a very popular and an economically significant fruit crop in many tropical and subtropical countries. Papaya is a short-lived, succulent, evergreen tree that bears papaya fruits throughout the year (Paltati and Kumar, 2016). Papaya is considered one of the most important fruits worldwide because of its high contents of

ascorbic acid (60.9 mg), Vitamin A (0.047 mg) and calcium (20 mg) per 100gm of fruit pulp. A single 100 g serving of papaya would be sufficient to cover the daily nutritional requirements for one person (Rajasekhar Pinnamaneni, 2017). Every part of papaya plant is said to have medicinal value. It has wide consumption owing to its pharmacological properties and can be used as folk remedy for various disorders (Jurandi *et al.,* 2011).

The perishable nature of papaya is a major drawback during storage and distant transportation. Papaya fruits are very susceptible to moisture loss and many fungal diseases causing enormous loss in fruit quality. Reports claim that about 30-50% of the harvested papaya never reach the consumers mainly due to postharvest spoilage (Mondal and Bose, 2007).

There are several methods for postharvest quality retention, but most of them are chemical based and thus pose health concerns owing to their residual toxicity, environmental pollution and their side effects on human health. Healthy and eco-friendly technologies are very popular. Natural plant extracts that are non-hazardous to both human health and environment are better alternatives to chemicals. Extracts obtained from plants have recently gained popularity and scientific interest for their antibacterial and antifungal activity (Santas *et al.,* 2010). Polysaccharides have been extensively used in edible coating. These coatings have greater ability to reduce the water loss and gaseous exchange. They also delay ripening and senescence. They are extracted from various plant species. Crystalline property of some polysaccharides causes the cross linkage to form a better coating. Cellulose, starch, gums, and chitosan are the most commonly used polysaccharide materials (Prasad *et al.,* 2018).

Materials and Methods

The experiment was conducted at PG Laboratory, College of Horticulture, Rajendranagar, Hyderabad during the year 2019-2020. The design adopted for the experiment was completely randomized design (CRD), with 7 treatments each having 3 replicates as per the procedure out lined by Panse and Sukhatme (1967).

Mature fruits of papaya cv. Red Lady as judged by presence of green colour with beginning of yellow bands of uniform size, free from diseases and injuries were selected and procured from a private orchard. Prior to the post-harvest treatment, the fruits were washed in potable water and then allowed to dry in shade. Then the fruits were subjected to edible bio-extract coating of following treatments: T_1- Aloe vera gel extract (20%), T_2 - Neem leaf extract (20%), T_3- Garlic extract (10%), T_4 - Ginger extract (20%), T_5 - Guar gum (1.5%), T_6 -Acacia gum (10%), T_7 was taken as control and stored at ambient temperature.

The fresh fruits were dipped in the coating solutions at room temperature for 5 min. At regular intervals, the fruits were rotated to increase the coating efficiency. They were allowed to drain for 2 min and then dried at room temperature.

Preparation of bio-extract coating solutions

Aqueous extracts of different bio-extract coatings i.e., Aloe vera gel extract (20%) and Neem leaf extract (20%), Garlic extract (10%) and Ginger extract (20%), Guar gum (1.5%), Acacia gum (10%) are prepared under laboratory conditions on percent weight basis by following the methods of Palei and Dash (2017), Singh and Majumdar (2001), Wijewardane *et al.,* (2013) and Khaliq *et al.,* (2015) respectively.

Observations regarding physical parameters were recorded at 3 days interval during the storage period. Physiological loss in weight was determined by recording the initial weight of fruits on the day of initiating experiment and subsequently at three days interval. The loss of weight in relation to initial weight was calculated and expressed in percentage. Fruit firmness was measured with a penetrometer (Deccan Techno Corporation, 0-20 kg) equipped with a probe of 8 mm diameter and expressed in kg/ cm^2. Fruit firmness without peel was measured manually using a penetrometer by dissecting each fruit vertically, each half placed on a table with the cut area facing up, and by pressing the plunger vertically into the flesh along the cut surface as followed by Azene *et al.,* (2014). Ripening was measured by counting the number of fruits ripened and expressed in percentage**.** Spoilage was measured by counting the number of fruits spoiled and expressed in percentage**.** The spoilage of fruits was determined based on the visual observations like shrivelling, fungal infection, rotting, over ripening, splitting, browning and discolouration of fruits. The shelf life of fruits was determined by recording the number of days the fruits remained in good condition in storage. The stage where in more than 50 percent of the stored fruits became unfit for consumption was considered as end of shelf life in that particular treatment and expressed as mean number of days (Padmaja and Bosco, 2014).

Results and Discussion

Physiological loss in weight (PLW)

Data presented in Table 1 revealed that on 3rd day of storage, significantly lowest PLW (2.07%) was recorded in T_2 (neem leaf extract 20%) followed by T_3 (garlic extract 10%) (2.82%) and the highest PLW was recorded in T_7 *i.e.*, control (6.41%) at ambient temperature. On 12th day of storage, significantly lowest PLW (11.14%) was recorded in T_2 (neem leaf extract 20%), which could be due to its ability to retard moisture loss and senescence mechanism. The ability of neem leaf extract to check the growth of microbes, responsible for rotting and high metabolic rate might be another probable reason behind its efficacy in reducing PLW. The reduced weight loss might also be due to the formation of thin layer of coating on surface of fruits that reduced the evapo-transpiration and respiration rate in the treated fruits (Gupta and Jain, 2014). The result obtained in the present investigation was similar with the result obtained by Siddiqua *et al.,* (2018) in banana.

Firmness with peel

On 3rd day of storage, significantly highest fruit firmness with peel (5.2 kg/ cm^2) was recorded in T_2 (neem leaf extract 20%), followed by T_3 (garlic extract 10%) (5.03 kg/ cm^2) and lowest firmness with peel was recorded in T_7 (2.83 kg/ cm^2) i.e., control fruits at ambient temperature as indicated by data presented in the Table 2. On 12th day of storage, significantly highest firmness with peel (1.23 kg/ cm^2) was recorded in T_2 (neem leaf extract 20%) treated fruits which may be due to the effect of azadirachtin on pectin molecules (Chauhan *et al.,* 2012). The result obtained in the present investigation was in accordance with the findings obtained by Kalio *et al.,* (2019) in mango.

Firmness without peel

Data presented in the Table 3 revealed that on 3rd day of storage, significantly highest fruit firmness without peel (4.73 kg/ cm^2) was recorded in T_2 (neem leaf extract 20%), followed by T_3 (garlic extract 10%) (4.43 kg/ cm^2) and lowest firmness without peel was recorded in T_7 (2.27 kg/ cm^2) i.e., in control

fruits treated fruits at ambient temperature. On 12th day of storage, significantly highest firmness without peel (0.93 kg/ cm^2) was recorded in T_2 (neem leaf extract 20%) treated fruits at ambient temperature.

In the present study, the firmness of fruits declined with progressive increase in storage period irrespective of treatment given to fruits. This was due to softening of fruits with the progress in storage time which could be due to texture modification through degradation of polysaccharides such as pectins, cellulose and hemicellulose that takes place during ripening (Shabina *et al.,* 2019). Fruits treated with neem leaf extract 20% showed higher firmness, which may be due to the effect of azardiractin on pectin molecules, delay in ripening and also on reduction of water loss (Chauhan *et al.,* 2012). Similar result was obtained by Shrestha *et al.,* (2018) in mango.

Table.1 Effect of bio-extracts on physiological loss in weight (%) of papaya cv. Red Lady

Treatment	PLW (%)			
	Days after storage			
	3	6	9	12
T_1 -Aloe vera gel extract (20%)	3.63	6.34	10.21	*
T_2 - Neem leaf extract (20%)	2.07	4.43	8.53	11.14
T_3 - Garlic extract (10%)	2.82	5.62	9.42	12.27
T_4 - Ginger extract (20%)	4.23	6.82	10.71	*
T_5 - Guar gum extract (1.5%)	5.39	7.21	11.62	*
T_6 - Acacia gum extract (10%)	5.63	7.89	12.31	*
T_7 - Control	6.41	11.21	*	*
Mean	4.31	7.07	10.46	11.70
S.Em±	0.019	0.018	0.016	0.031
CD at 5%	0.059	0.055	0.049	0.096

*End of shelf life

Table.2 Effect of bio-extracts on fruit firmness with peel (kg/cm^2) of papaya cv. Red Lady

Treatment	Firmness with peel (kg/cm^2)			
	Days after storage			
	3	6	9	12
T_1 -Aloe vera gel extract (20%)	4.43	2.77	1.43	*
T_2 - Neem leaf extract (20%)	5.20	3.17	2.17	1.23
T_3 - Garlic extract (10%)	5.03	3.03	2.00	1.03
T_4 - Ginger extract (20%)	4.17	2.63	1.30	*
T_5 - Guar gum extract (1.5%)	3.93	2.37	1.17	*
T_6 - Acacia gum extract (10%)	3.77	2.13	1.03	*
T_7 - Control	2.83	1.13	*	*
Mean	4.19	2.46	1.52	1.13
S.Em±	0.031	0.033	0.025	0.018
CD at 5%	0.095	0.102	0.077	0.055

*End of shelf life

Table.3 Effect of bio-extracts on fruit firmness without peel (kg/cm^2) of papaya cv. Red Lady

Treatment	Firmness without peel (kg/cm^2)			
	Days after storage			
	3	6	9	12
T_1 -Aloe vera gel extract (20%)	4.03	2.37	1.13	*
T_2 - Neem leaf extract (20%)	4.73	2.77	1.77	0.93
T_3 - Garlic extract (10%)	4.43	2.47	1.53	0.77
T_4 - Ginger extract (20%)	3.77	2.23	0.87	*
T_5 - Guar gum extract (1.5%)	3.43	2.03	0.73	*
T_6 - Acacia gum extract (10%)	3.27	1.67	0.67	*
T_7 - Control	2.27	0.63	*	*
Mean	3.70	2.02	1.12	0.85
S.Em±	0.033	0.033	0.031	0.018
CD at 5%	0.102	0.102	0.095	0.055

*End of shelf life

Table.4 Effect of bio-extracts on ripening (%) of papaya cv. Red Lady

Treatment	Ripening percentage (%)			
	Days after storage			
	3	6	9	12
T_1 -Aloe vera gel extract (20%)	20.00	43.33	91.11	*
T_2 - Neem leaf extract (20%)	6.67	20.00	44.45	93.33
T_3 - Garlic extract (10%)	13.33	26.67	48.89	97.78
T_4 - Ginger extract (20%)	26.67	43.33	93.33	*
T_5 - Guar gum extract (1.5%)	28.89	46.67	95.55	*
T_6 - Acacia gum extract (10%)	33.33	51.11	97.85	*
T_7 - Control	46.67	100.00	*	*
Mean	25.08	47.30	78.53	95.55
S.Em±	0.839	0.420	1.878	0.840
CD at 5%	2.570	1.285	5.753	2.574

*End of shelf life

Table.5 Effect of bio-extracts on spoilage (%) of papaya cv. Red Lady

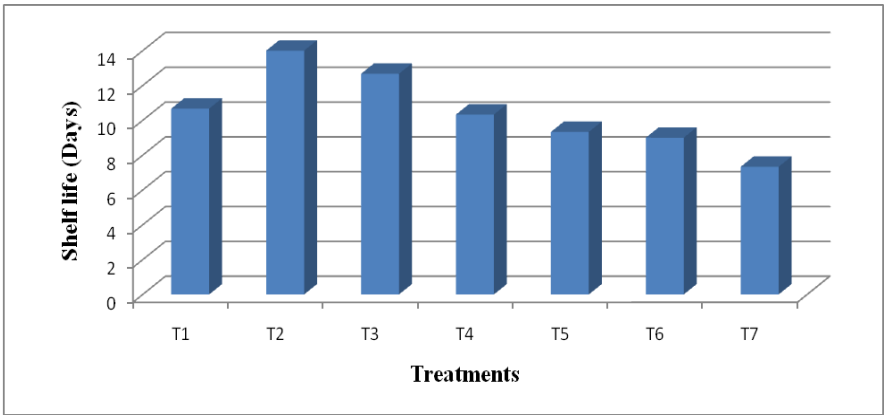
Treatment	Spoilage (%)			
	Days after storage			
	3	6	9	12
T_1 -Aloe vera gel extract (20%)	0.00	20.00	42.22	*
T_2 - Neem leaf extract (20%)	0.00	6.67	22.22	42.22
T_3 - Garlic extract (10%)	0.00	13.33	28.89	48.89
T_4 - Ginger extract (20%)	0.00	26.67	42.22	*
T_5 - Guar gum extract (1.5%)	0.00	31.11	44.45	*
T_6 - Acacia gum extract (10%)	0.00	33.33	46.67	*
T_7 - Control	0.00	46.67	*	*
Mean	0.00	25.4	37.78	45.55
S.Em±	0.00	0.839	1.878	1.188
CD at 5%	0.00	2.570	5.753	3.637

*End of shelf life

Table.6 Effect of bio-extracts on shelf life (days) of papaya cv. Red Lady

Treatment	Shelf life (days)
T_1 -Aloe vera gel extract (20%)	10.67
T_2 - Neem leaf extract (20%)	14.00
T_3 - Garlic extract (10%)	12.67
T_4 - Ginger extract (20%)	10.33
T_5 - Guar gum extract (1.5%)	9.33
T_6 - Acacia gum extract (10%)	9.00
T_7 - Control	7.33
Mean	10.47
S.Em±	0.282
CD at 5%	0.863

Fig.1 Effect of bio-extracts on shelf life (days) of papaya cv. Red Lady



T_1 - Aloe vera gel extract (20%); T_2 - Neem leaf extract (20%); T_3 – Garlic extract (10%); T_4 - Ginger extract (20%); T_5 - Guar gum extract (1.5%); T_6 - Acacia gum extract (10%); T_7 -Control

Ripening

Data presented in Table 4 revealed that on 3rd day of storage, significantly lowest ripening (6.67%) was recorded in T_2 (neem leaf extract 20%), followed by T_3 (garlic extract 10%) (13.33%) and the highest ripening (46.67%) was recorded by T_7 i.e., in control fruits at ambient temperature. On 12th day of storage, significantly lowest ripening (93.33%) was recorded in T_2 (neem leaf extract 20%) treated fruits which may be due to reduced respiration. The results are in accordance with the findings of Deshmukh *et al.*, (2020) in Nagpur mandarins.

Spoilage

Spoilage was not recorded in both coated and uncoated fruits on 3rd day of storage. On 6th day of storage, significantly lowest spoilage (6.67%) was recorded in T_2 (neem leaf extract 20%), followed by T_3 (garlic extract 10%) (13.33%) and the highest spoilage was recorded in T_7 (46.67%) i.e., in control fruits at ambient temperature as indicated by data presented in Table 5. On 12th day of storage, significantly lowest spoilage (42.22%) was recorded in T_2 (neem leaf extract 20%) which may be attributed to the presence of principle compound azadiractin which has the ability to check the growth of pathogenic

microorganisms that are responsible for rotting (Gupta and Jain, 2014). Similar result was obtained by Malik *et al.*, (2015) in guava.

Shelf Life

Data presented in Table 6 and Figure 1 revealed that significantly highest shelf life (14 days) was recorded in T_2 (neem leaf extract 20%), followed by T_3 (garlic extract 10%) (12.67 days) and lowest shelf life (7.33 days) was recorded in T_7 i.e., in control at ambient temperature. Highest shelf life seen in neem leaf extract 20% treated fruits at ambient temperature may be due to lowest PLW, ripening, spoilage percentage and higher firmness observed in neem leaf extract 20% treated fruits because of antifungal properties of neem preventing the microbial growth and its thin film reducing the evapotranspiration and respiration rate. The result obtained in the present investigation was in line with the findings obtained by Siddiqua *et al.*, (2018) in banana.

Results of the experiment revealed that different bio- extract coatings significantly affected the shelf life and physical parameters of papaya cv. Red Lady fruit. Among the different bio-extract coatings, neem leaf extract (20%) was best in terms of extending shelf life and maintaining physical parameters without causing adverse effects, followed by garlic extract (10%) treatment.

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