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Studies on Postharvest Quality and Shelf Life of Pink Fleshed Dragon Fruit (*Hylocereus* spp.) Coated with Chitosan and Stored at Ambient Temperature

R. Prashanth[1*], A. Kiran Kumar[2], M. Rajkumar[3] and K. Aparna[4]
[1]*Research Scholar, Department of Fruit Science, College of Horticulture, Rajendranagar, Sri Konda Laxman Telangana State Horticultural University, Hyderabad (Telangana), India.*
[2]*Professor (Hort.),Comptroller and Dean of Horticulture, Sri Konda Laxman Telangana State Horticultural University, Mulugu (M&V), Siddipet (Telangana), India.*
[3]*Principal Scientist (Hort.) & Head, Fruit Research Station, Sangareddy (Telangana), India.*
[4]*Senior Scientist (Foods and Nutrition) & Head, MFPI-Quality Control Laboratory, Professor Jayashankar Telangana State Agricultural University, Hyderabad (Telangana), India.*

(Corresponding author: R. Prashanth)*
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ABSTRACT: Dragon fruit undergoes rapid senescence during storage. This study identified the synergistic effect of chitosan coating with different concentrations on the postharvest quality and shelf life of dragon fruits stored at ambient conditions. This study was conducted in completely randomized design. Dragon fruits were coated with 2 %, 3 %, and 4 % chitosan solution and stored at ambient temperature for 14 days. Changes in fruit's physiological loss of weight(PLW), firmness, shelf life, total soluble solid (TSS), titratable acidity (TA), reducing sugars, total sugars, ascorbic acid as well as decay rate were periodically recorded. The results indicated that the chitosan coating with 4 % significantly reduced the decrease of PLW, firmness, TSS, TA, ascorbic acid content and partially inhibited decay. These results also showed that chitosan coating @ 4%is the most effective treatment for improving the postharvest quality and prolong the shelf life of dragon fruits when stored at ambient condition.

Keywords: Dagon fruit (*Hylocereus* spp.), Chitosan, Coating, Post-harvest quality, Shelf life, Ambient storage.

INTRODUCTION

Dragon fruit (*Hylocereus* spp.) is diploid (2n = 22) and belongs to the genus *Hylocereus* of the family Cactaceae and subfamily Cactoideae. Dragon fruit has gained global attention due to its prominent vivid red color, delicate flavor and nutritional value. The major constraints in dragon fruit during storage is the short shelf life it is due to several factors such as high respiration, weight loss and increased ripening process which causes shriveling of fruit after the eighth day of harvesting (Ali *et al*., 2013). In tropical regions, the main factor which reduces the shelf life of fruit is high temperature, which results in high respiration of fruit, rapid ripening and thus early deterioration of fruit quality. The chemical composition of fruit during ripening changes dramatically and depends on texture, flavour, titratable acidity and ascorbic acid content.

Many physical and chemical processes have been developed to preserve fresh fruits and vegetables, among them adequate packaging is one of the most commonly used technique.

Chitosan, a natural alkaline polysaccharide, has become one of the most popular edible film materials in recent years owing to its non-toxicity and superior biocompatibility. Chitosan is widely used as a food additive and a suitable alternative to synthetic fungicides for treating postharvest fruits and vegetables (Romanazzi *et al*., 2017). Chitosan as a natural and environmentally friendly compound is obtained from deacetylation of chitin (Khoshgozaran Abras *et al.,* 2012). Chitosan and its derivatives increase shelf life of a wide range of vegetables and fruits by inhibiting decay. So, one of interest application of this biopolymer is products preservation because of its ability to be used as coating materials (Chien *et al*., 2007; Devlieghere *et al*., 2004; Qiuping and Wenshui 2007; Sabir *et al*., 2019). The function of chitosan as an antimicrobial material attributed to amino groups or hydrogen bonding between chitosan and extra cellular polymers (Hughes *et al*., 1994). As a biopolymer, chitosan has excellent film forming properties and is able to form a semipermeable film on fruit which may modify the internal atmosphere, as well as decrease weight loss and shriveling due to transpiration and improve overall fruit quality (Hong *et al*., 2012; Xing *et al*., 2011). Chitosan coating maintains fruit quality during storage by preventing the loss of fruit weight, soluble solid contents, vitamin C, titratable acidity, and firmness (Chiabrando and Giacalone, 2013; Lin *et al*., 2020; Romanazzi *et al*., 2002). Krishna and Rao (2014) reported that chitosan treatment (1%) extending the shelf life of guava up to 7 days by delaying ripening and preventing physiological loss in weight. Chitosan formulated with cassava starch significantly preserved fruit weight, color, aroma and texture of mango and increased shelf life by decreasing the respiration rate without negative effect on the fruit ripening (Camatari*et al*., 2018).

Keeping all these in view, the present investigation was undertaken to study the effect of different concentrations of chitosan as an edible coating on postharvest quality and shelf life of pink fleshed dragon fruits stored at ambient conditions.

Experimental site. The experiment was conducted at PG laboratory, Sri Konda Laxman Telangana State Horticultural University, College of Horticulture, Rajendranagar, Hyderabad.

MATERIAL AND METHODS

Fruits. Dragon fruits used for the research were procured from Deccan exotics dragon fruit farm, Sangareddy, Telangana, which was located at 17°34'29" N latitude and 78°0'58" E longitude and at an elevation of 520m mean sea level.

Chemicals. All chemicals used in experimentation and analysis were of analytical grade, purchased from Standard Indian Chemical companies.

Methodology:

Preparation of chitosan solution. After sorting and grading, healthy fruits were divided in to four equal lots. Chitosan solutions at concentrations of 2%, 3% and 4% were prepared according to the method described by (Ali *et al*. 2013).

Briefly,2%, 3% and 4% chitosan solution were prepared by dissolving 20g, 30g and 40g of chitosan powder in 1000ml of distilled water and 10 ml of acetic acid. The solution was followed by stirring using an overhead stirrer at a speed of 500 rpm for 20 min till a transparent solution is obtained.

Method of application of treatments. Fresh and fully matured uniform sized and disease-free dragon fruits were washed with tap water to remove the dirt and dust particles and dried at room temperature.

The dipping treatment of chitosan coating to all the samples was done at ambient conditions for 10 minutes and stored at ambient temperature. The analysis of the fruits was done at every 2 days interval.

Experimental details

Treatments

• T_1 - Chitosan 2%, T_2 - Chitosan 3%, T_3 - Chitosan 4%, T_4 - Control

Observations recorded

Physiological loss in weight (%). Physiological loss in weight (PLW) was determined by recording the initial weight of the fruits on the day of initiating experiment and subsequently at two days interval. The loss of weight in grams and in relation to initial weight was calculated and expressed in percentage.

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

Decay (%): The percent decay (%) of fruits was calculated on the number basis by counting number of fruits decayed and total fruits at each storage interval. The decay was calculated as follows

$$\text{Decay}\ (\%) = \frac{\text{Number of spoiled fruits}}{\text{Total number of fruits}} \times 100$$

Fruit firmness (Kg cm^{-2}). Penetrometer was used to record the firmness of fruits and direct readings were obtained in terms of kg cm^{-2}. The sample fruits were subjected to penetrometer by pressing near the center of the fruit and direct reading on the scale was recorded at two days intervals.

Shelf Life (days). Shelf life of the fruits was determined by recording the number of days the fruits remained in good condition in storage. The stage where in more than 50 per cent 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).

Total Soluble Solids (^{o} B). Total Soluble solids were determined (AOAC, 1965) by using refractometer expressed as ˚B. A drop of the homogenized dragon fruit pulp was squinted on the prism of refractometer and observing the coincidence of shadow of the sample with the reading on the scale and mean values in ˚B were expressed as total soluble solids. The percentage of TSS was obtained from direct reading on the instrument.

Titratable acidity (%). Titratable acidity (TA) Titratable acidity was determined by adding 2 drops of 0.1% phenolphthalein solution to 5 mL of fruit juice and titration against 0.1 N NaOH until the pH reached 8.1. The fruit juice was obtained by homogenizing 10 g of fruit pulp from a mixture of 4 fruit in a kitchen blender with 10 mL of purified water. The mixture was centrifuged at 5000 × g for 5 min and then filtered through a cheese cloth. The results were expressed as percentage of citric and l-lacticacids (mg/100 g of fresh weight) (Ali *et al*., 2013).

$$\text{Acidity}\ (\%) = \frac{\text{Weight of sample} \times \text{Vol. of aliquot} \times 1000}{\text{Titre} \times \text{Normality of alkali} \times \text{vol made} \times \text{eq. wt of acid} \times 100}$$

Total Sugars (%). Total sugars were estimated by taking above 50 ml sample in volumetric flask. To this sample, five ml of HCl was added, mixed well and allowed to stand for overnight. On next day, acid was then neutralized with NaOH using a drop of phenolphthalein as an indicator till the pink colour persisted for at least few seconds. After this the final volume of the sample was made 100 ml by adding distilled water and total sugars were estimated then by titrating sample against the Fehling solution (5 ml A+ 5 ml B) using methylene blue as an indicator and the titration was done till the appearance of brick red colour as in reducing sugars. The results were expressed in percentage.

$$\text{Total sugars}\ (\%) = \frac{\text{Factor} * \text{volume made up}}{\text{Titre value} * \text{weight of sample}} \times 100$$

Reducing Sugars (%). The reducing sugars were determined by the method of Lane and Eyon (AOAC, 2006). The results were expressed in percentage.

Total sugars (%)

$$= \frac{\text{Factor} * \text{volume made up}}{\text{Titre value} * \text{weight of sample}} * 100$$

Ascorbic acid content (mg 100g^{-1})

The indophenol-xylene extraction method for ascorbic acid and modifications for interfering substances by (Robinson and Stotz,1945).

$$(\%) = \frac{\text{Ascorbic acid content from the standard curve} * 100 * 100}{2 * \text{weight of sample taken for extraction}} * 100$$

$$(\%) = \frac{\text{Ascorbic acid content from the standard curve} * 5000}{\text{weight of sample taken for extraction}}$$

Result. Ascorbic acid of the sample = ………. mg per 100 mg.

Statistical analysis. The design adopted was completely randomized design (CRD) and the data was processed at the Computer centre, Professor Jayashankar Telangana State Agricultural University, Rajendranagar, Hyderabad using the established statistical analysis as per the procedure (window stat version 9.1) outlined by Murali Khetan (2012). Significance was tested by 'F' value at 5 per cent level of significance.

RESULTS AND DISCUSSION

Physiological loss of weight

Application of chitosan coating retarded the weight loss of dragon fruits during storage compared to the control. There was an added benefit to control of weight loss by increasing concentrations of chitosan from 2 to 4%. The lowest weight loss was found in 4% chitosan followed by 3 and 2% chitosan and then uncoated after 14 days of storage. The highest weight loss (10.56) was observed in untreated dragon fruits at the 8th day of storage, whereas the lowest weight loss (1.56) was observed in fruits coated with 4% chitosan at the same day of storage as shown in the Table 1.Among the chitosan concentrations, 4% resulted in the best in terms of controlling weight loss of dragon fruit during storage. Similar results were demonstrated by (Nguyen *et al*., 2021).

Decay (%). The effect of chitosan coating on the decay of dragon fruit stored at room temperature at different intervals is presented in Table 2, the percent decay values showed an increasing trend from the 2nd day to 14th day during storage. On the 2nd and 4th day of storage at ambient conditions, the fruits appeared fresh without any change on their surface. Hence percent decay values for chitosan coated fruits and control recorded (0).On the 8th day of storage T_4 -Control recorded the highest decay percent (20) followed by T_1-Chitosan @ 2% (10), T_2-Chitosan @3% (4) percent decay. While T_3-Chitosan @4% (0) or no decay. A similar trend of increasing decay percent was observed up to the 14th day of storage under ambient conditions.

Among all the treatments, fruits treated with chitosan @ 4% showed minimum score. Similar results were demonstrated by (Woolf *et al*., 2006).

Firmness (kg cm^{-2}). Fruit firmness is often the first of many quality attributes judged by the consumer and is, therefore, extremely important in overall product acceptance. Dragon fruit suffers a rapid loss of firmness during senescence which contributes greatly to its short postharvest life and susceptibility to fungal contamination. Changes in flesh firmness between control and coated fruit samples during 14 days of storage at ambient conditions are shown in Table 3. Initial flesh firmness values were similar for control and coated samples. On the 2nd day of storage uncoated dragon fruits began to show a gradual loss of firmness.On the 2nd day, fruits treated with T_3-Chitosan @ 4% recorded the highest value of firmness (6.04) followed by T_2-Chitosan @ 3% (5.52), T_1-Chitosan @ 2% (5.20) while the lowest firmness was recorded was noticed in T_4 -Control (5.06). A similar trend of decreasing firmness of dragon fruits with the increase in storage period was observed up to 14th day at ambient conditions. On the 14th day of storage, except T_3-Chitosan @4% (2.04) all other treatments noticed the end of shelf life. From the result, it is observed that the highest firmness was observed with fruits treated with Chitosan coated with 4%. The progressive loss of firmness is the result of a gradual transformation of protopect in into pectin which is degraded by the enzyme poly galacturonate in the cell wall as reported by Hobson (1968). Maximum deterioration and minimal degree of firmness indicate the maximum quality degradation. The highest firmness may be due to a low rate of respiration due to the application of surface coating which slowdowns the metabolic activity of fruits leading to retention of firmness in fruits. The findings are in accordance with (Ali *et al*., 2013) in dragon fruit, (Rama Krishna and Sudhakar Rao 2014).

Shelf life. The data pertaining to the Shelf life of dragon fruits treated with chitosan coating is presented in Table 4.The highest shelf life of (13.80 days) was recorded in T_3-Chitosan @4% dragon fruit followed by T_2-Chitosan @3% (10.60days), T_1-Chitosan @2% (9.80 days) while the lowest shelf life was recorded in T_4-Control (7.80 days).Dragon fruits treated with Chitosan 4% recorded the highest shelf life as chitosan coatings reduce shrinkage by reducing loss of moisture, transpiration and respiration losses thereby retaining the freshness of the fruits.

The present results are in conformity with the findings of (Chutichudet and Chutichudet, 2011) in dragon fruit, (Hening, 1975) in apple ber, (Sandeep and Bal 2003) in apple ber, (Sabir and Sabir 2009) in table grape and (Romanazzi*et al*., 2009) in table grape.

Total soluble solids. The effect of chitosan coating at ambient storage condition of dragon fruits on total soluble solids is presented in Table 5. Total soluble solids increase with the storage period in room temperature up to the 6^{th} day and it starts decreasing from the 8th day except for T_3-Chitosan @4%.On the 2^{nd} day, of storage the highest TSS was recorded in T_4-Control (15.56) which was followed by T_1-Chitosan @2% (15.16) and the lowest TSS was noticed inT_2-Chitosan@3% (14.36) which was statistically on par with T_3 -Chitosan @ 4% (14.24). On the 8^{th} day, started decreasing TSS in T_1-Chitosan @2% (16) followed by T_4-Control (15.17), T_2-Chitosan @3% (15). Whereas in T_3-Chitosan @4% (14.88) increasing in TSS was noticed. The similar trend was observed on 10^{th}, 12^{th} and 14^{th} day of storage.On the 14^{th} day of storage, except T_3-Chitosan @4% all other treatments showed the end of shelf life with T_3-Chitosan @4% recorded highest TSS value (15).

*Hylocereu*s species with white flesh have higher soluble solids contents than those with red flesh fruit and the distribution of soluble solids in the fruit flesh is not homogeneous, the core part being richer in sugars than the peripheral part (Wu *et al*., 1997). A large percentage of the soluble solids in dragon fruit are sugars mainly glucose and fructose that are central and are involved in cell respiration and synthesis and the third sugar is sucrose that is non-reducing by nature and presents relatively in smaller amounts.

From the above results, it can be concluded that the fruits treated with Chitosan 4% recorded a slower increase in TSS. The fruits treated with higher concentrations could have been due to slowing down the rate of respiration and metabolic activity, hence retarding ripening (Ali *et al.,* 2013) in dragon fruit, (Jafarizadeh *et al*., 2011).

Titratable acidity (%). The effect of surface coating at ambient storage condition of dragon fruits on titratable acidity of dragon fruit stored at room temperature affected by surface coating was presented in Table 6. The acidity of fruits decreases with the progress in the storage period.

There was no significant difference among treatments in ambient storage conditions on the 2^{nd} day of storage. On the 4^{th} day fruits treated with T_3-Chitosan@4% recorded the highest value of titratable acidity (0.42) followed by T_2-Chitosan @3% (0.37) which was on par with T_1-Chitosan @2% (0.35). While the lowest was recorded in T_4 -Control (0.33). A similar trend was noticed with respect to titratable acidity content on the 6^{th} and 8^{th} day respectively.

On the 10^{th} day, fruits treated with T_3-Chitosan recorded the highest value of titratable acidity (0.26) followed by T_2-Chitosan @3% (0.20), T_1-Chitosan @2% (0.15) whereas T_4- Control showed the end of shelf life, similar trend was observed on 12^{th} and 14^{th} day of storage. On the 14^{th} day of storage, except T_3-Chitosan @4% all other treatments showed the end of shelf life. In T_3-Chitosan @4%titrable acidity content recorded was (0.12).

Titratable acidity (TA) values decreased in chitosan coated and uncoated fruit, with a significant difference after 14 days of storage. However, the maximum decrease in TA was recorded in the control fruit, while a slight decrease was observed in fruit treated with T_3-Chitosan @4%.Titratable acidity of fruits decreases due to the increase of soluble sugars during ripening. This decrease was observed less in fruits coated with surface coating compared to control due to edible coatings. Similar findings were reported by (Ali *et al.,* 2013) in dragon fruit and (Baviskar *et al*., 1995) in ber fruits where acidity decreased continuously towards the end of the storage period regardless of post-harvest treatments and storage conditions.

Total sugars (%). The effect of chitosan coating on total sugars present in dragon fruit is represented in the Table 7. Total sugars content increased with the storage period at room temperature from 1^{st} day to the 8^{th} day.

On the 2^{nd} day, the highest total sugars content was recorded in T_4 -Control (8.04) followed by T_1-Chitosan @2% (7.80), T_2-Chitosan @3% (7.70) and the lowest total sugars content was noticed in T_3-Chitosan @4% (7.64). A similar trend was noticed with respect to total sugar content on the 4^{th}, 6^{th},8^{th} and 10^{th} day respectively. On the 12^{th} day of storage, the highest total sugar content was recorded in T_3-Chitosan @4% (7.92) and all other treatments showed the end of shelf life. On the 14^{th} day of storage, T_3-Chitosan @4% recorded total sugar content (7.42), all other treatments showed the end of shelf life.

The results of this study revealed that T_3-Chitosan 4% was the best treatment, chitosan treatments formed a semi-permeable film around the fruit which suppressed ethylene production and restored TSS content in the fruit. Suppression of respiration also slows down the synthesis and use of metabolites resulting in lower TSS due to the slower hydrolysis of carbohydrates to sugars. Our results are in line with those of (Kittur *et al*., 2001) where a slow rise in total sugar content was recorded in mango and banana treated with chitosan.

The total sugars content increased during the storage period in all treatments. The raise in sugars may be due to conversion of starch into sugars. Similar observation was reported by (Nerd *et al.,* 1999) in dragon fruit and (Ramchandra and Ashok 1997) in ber.

Reducing sugars (%). The effect of chitosan coating on reducing sugars of dragon fruit are presented in Table 8. On the 2^{nd} day, the highest reducing sugar content was recorded in T_4 -Control (3.95) which was on par with T_1-Chitosan @2% (3.95) and T_2-Chitosan @3% (3.94) and the lowest reducing sugars was noticed in T_3-Chitosan @4% (3.79).

On the 4^{th} day highest reducing sugar content was recorded in T_4-Control (4.18) followed by T_1-Chitosan @2% (4.10), T_2-Chitosan @3% (4.00) and the lowest reducing sugars were noticed in T_3-Chitosan @4% (3.88). A similar trend was noticed with respect to reducing sugar content on the 6^{th}, 8^{th}, 10^{th} and 12^{th} day respectively. On the 14^{th} day of storage, except T_3-Chitosan @4% all other treatments showed the end of shelf life. T_3-Chitosan @4% recorded reducing sugar content (4.96).

The total and reducing sugars were increased in all treatments. The raise in sugars may be due to conversion of starch into sugars during storage. Similar observation was reported by (Nerd *et al* 1999) in dragon fruit and (Ramchandra and Ashok 1997) in ber.

Ascorbic acid content (mg/100g). Ascorbic acid content in dragon fruit pulp gradually decreased during storage and this reduction was effectively inhibited by 3 and 4% chitosan coating as shown in Table 9. On the 2nd day, there was a significant difference observed among the treatments with the highest ascorbic acid content in T_3-Chitosan @ 4% (9.98) followed by T_2-Chitosan @ 3% (9.86) which was on par with T_1-Chitosan @ 2% (9.84) and T_4-Control (9.78). On the 4th day, fruits treated with T_3-Chitosan @ 4% recorded the highest value of ascorbic acid content (9.85), which was on par with T_2-Chitosan @3% (9.81), T_1-Chitosan @ 2% (9.77) while the lowest was recorded in T_4-Control (9.60). A similar trend was noticed with respect to ascorbic acid content on the 6th, 8th, 10th and 12th day respectively. On the 14th day of storage, ascorbic acid content recorded in T_3-Chitosan @4% was (8.62).

Dragon fruits coated with Chitosan 4% recorded the highest ascorbic acid content. The decreasing trend of ascorbic acid is less in chitosan coated fruits compared to control where there is a rapid decrease of ascorbic acid. This may be due to an increase in total soluble sugars in the fruits and it also suggests that the modified atmosphere created by chitosan coating suppresses the loss of ascorbic acid.The results obtained were close to the findings of (Jagtar Singh *et al*., 1978) in ber.

Table 1: Effect of chitosan coating on physiological loss of weight of pink fleshed dragon fruit stored at ambient conditions.

Treatments	**Physiological loss of weight (%)**						
	2nd day	**4th day**	**6th day**	**8th day**	**10th day**	**12th day**	**14th day**
T_1 - Chitosan (2%)	0.53^{ab}	2.09^{b}	5.24^{b}	8.36^{b}	10.99^{a}	*	*
T_2 - Chitosan (3%)	0.51^{ab}	1.57^{b}	3.14^{c}	4.47^{c}	7.05^{b}	*	*
T_3 - Chitosan (4%)	0.25^{ab}	0.73^{c}	1.26^{d}	1.79^{d}	2.72^{c}	4.64^{a}	6.30^{a}
T_4 - Uncoated	0.78^{a}	3.08^{a}	5.78^{a}	10.56^{a}	*	*	*
SE(m)±	0.01	0.02	0.01	0.06	0.03	0.02	0.07
CD @5%	0.02	0.05	0.03	0.18	0.07	0.06	0.22

* end of shelf life

Table 2: Effect of chitosan coating on decay %of pink fleshed dragon fruit stored at ambient conditions.

Treatments	**Decay (%)**				
	6th day	**8th day**	**10th day**	**12th day**	**14th day**
T_1 - Chitosan (2%)	5^{b}	10^{b}	15^{b}	20^{b}	30^{b}
T_2 - Chitosan (3%)	1^{c}	4c	7^{c}	10^{c}	20.5^{c}
T_3 - Chitosan (4%)	0	0	3^{d}	5^{d}	10.5^{d}
T_4 - Uncoated	10^{a}	20^{a}	35^{a}	50^{a}	70^{a}
SE(m)±	0.1	0.1	0.12	0.32	0.28
CD @5%	0.3	0.3	0.37	0.95	0.85

* end of shelf life

Table 3: Effect of chitosan coating on firmness (kg cm^{-2}) of pink fleshed dragon fruit stored at ambient conditions.

Treatments	**Firmness (kg cm^{-2})**						
	2nd day	**4th day**	**6th day**	**8th day**	**10th day**	**12th day**	**14th day**
T_1 - Chitosan (2%)	5.20^{b}	4.08^{c}	$3.86a^{b}$	3.28^{c}	2.66^{c}	*	*
T_2 - Chitosan (3%)	5.52^{ab}	4.24^{b}	3.88^{ab}	3.34^{b}	2.88^{b}	*	*
T_3 - Chitosan (4%)	6.04^{a}	4.56^{a}	4.04^{a}	3.58^{a}	3.16^{a}	3.02^{a}	2.04^{a}
T_4 - Uncoated	5.06^{b}	3.90^{d}	3.44^{b}	2.66^{d}	*	*	*
SE(m)±	0.03	0.03	0.03	0.03	0.06	0.02	0.03
CD @5%	0.08	0.09	0.08	0.08	0.18	0.06	0.09

* end of shelf life

Table 4: Effect of chitosan coating on shelf life of pink fleshed dragon fruit stored at ambient conditions.

Treatments	**Shelf life (days)**
T_1 - Chitosan (2%)	9.80^{c}
T_2 - Chitosan (3%)	10.60^{b}
T_3 - Chitosan (4%)	13.80^{a}
T_4 - Uncoated	7.80^{d}
SE(m)±	0.21
CD @5%	0.64

* end of shelf life

Table 5: Effect of chitosan coating on total soluble solids (°B) of pink fleshed dragon fruit stored at ambient conditions.

Treatments	Total soluble solids (°B)						
	2nd day	**4th day**	**6th day**	**8th day**	**10th day**	**12th day**	**14th day**
T_1 - Chitosan (2%)	15.16b	15.58b	16.02b	16.0a	11.14c	*	*
T_2 - Chitosan (3%)	14.36c	14.84c	15.32c	15c	13.38b	*	*
T_3 - Chitosan (4%)	14.24cd	14.52d	14.76d	14.88cd	15.34a	15.54a	15.00a
T_4 - Uncoated	15.56a	16.20a	17.22a	15.17b	*	*	*
SE(m)±	0.04	0.02	0.05	0.05	0.06	0.12	0.28
CD @5%	0.13	0.07	0.15	0.15	0.17	0.36	0.83

* end of shelf life

Table 6: Effect of chitosan coating on titratable acidity (%) of pink fleshed dragon fruit stored at ambient conditions.

Treatments	Titratable acidity(%)						
	2nd day	**4th day**	**6th day**	**8th day**	**10th day**	**12th day**	**14th day**
T_1 - Chitosan (2%)	0.48a	0.35b	0.28c	0.24ab	0.15c	*	*
T_2 - Chitosan (3%)	0.48a	0.37b	0.31b	0.29a	0.20b	*	*
T_3 - Chitosan (4%)	0.48a	0.42a	0.35a	0.31a	0.26a	0.15a	0.12a
T_4 - Uncoated	0.48a	0.33c	0.29c	0.17c	*	*	*
SE(m)±	0.02	0.01	0.0	0.01	0.01	0.01	0.01
CD @5%	0.07	0.02	0.01	0.03	0.03	0.02	0.03

* end of shelf life

Table 7: Effect of chitosan coating on total sugars (%) of pink fleshed dragon fruit stored at ambient conditions.

Treatments	Total Sugars (%)						
	2nd day	**4th day**	**6th day**	**8th day**	**10th day**	**12th day**	**14th day**
T_1 - Chitosan (2%)	7.80b	8.16b	8.40b	8.70b	7.94c	*	*
T_2 - Chitosan (3%)	7.70c	8.04	8.22c	8.48c	8.09b	*	*
T_3 - Chitosan (4%)	7.64d	7.85	7.94d	8.16d	8.32a	7.92a	7.42a
T_4 - Uncoated	8.04a	8.53a	9.0a	9.28a	*	*	*
SE(m)±	0.01	0.0	0.02	0.02	0.03	0.03	0.01
CD @5%	0.04	0.0	0.05	0.05	0.10	0.09	0.03

* end of shelf life

Table 8: Effect of chitosan coating on reducing sugars (%) of pink fleshed dragon fruit stored at ambient conditions.

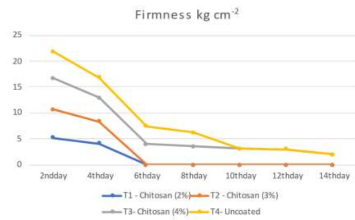
Treatments	Reducing Sugars (%)						
	2nd day	**4th day**	**6th day**	**8th day**	**10th day**	**12th day**	**14th day**
T_1 - Chitosan (2%)	3.95a	4.10b	4.31b	5.02b	4.68b	*	*
T_2 - Chitosan (3%)	3.94a	4.00c	4.20c	4.50c	4.91a	*	*
T_3 - Chitosan (4%)	3.79b	3.88c	4.04d	4.20d	4.57c	4.78a	4.96a
T_4 - Uncoated	3.95a	4.18a	4.60a	5.16a	*	*	*
SE(m)±	0.01	0.02	0.02	0.02	0.03	0.02	0.01
CD @5%	0.04	0.07	0.07	0.07	0.09	0.06	0.04

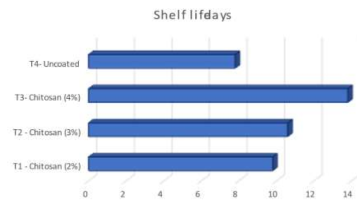
* end of shelf life

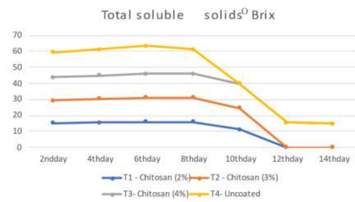
Table 9: Effect of chitosan coating on ascorbic acid (mg $100g^{-1}$) of pink fleshed dragon fruit stored at ambient conditions.

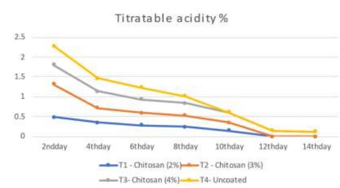
Treatments	Ascorbic acid (mg$100g^{-1}$)						
	2nd day	**4th day**	**6th day**	**8th day**	**10th day**	**12th day**	**14th day**
T_1 - Chitosan (2%)	9.84b	9.77abc	9.47b	9.29b	8.67c	*	*
T_2 - Chitosan (3%)	9.86b	9.81ab	9.51b	9.10c	8.77b	*	*
T_3 - Chitosan (4%)	9.98a	9.85a	9.63a	9.36a	9.03a	8.77a	8.62a
T_4 - Uncoated	9.78bc	9.60d	9.27c	8.74d	*	*	*
SE(m)±	0.03	.03	0.03	0.03	0.02	0.02	0.02
CD @5%	0.06	0.09	0.08	0.09	0.06	0.05	0.05

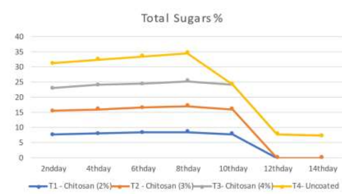
*end of shelf life

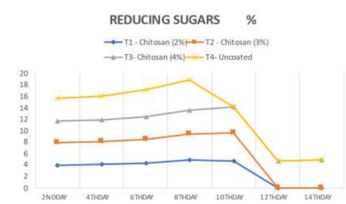


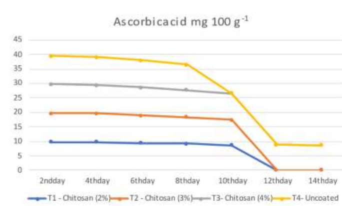












CONCLUSIONS

In conclusion, the experiment conducted here indicated that the application of chitosan coating, especially T_3-Chitosan 4% recorded significantly higher results in terms of minimum PLW, decay percent and highest firmness, shelf life and quality parameter namely TSS,TA, sugars and ascorbic acid content. It was followed by T_2-chitosan 3% in pink fleshed dragon fruits storage at ambient conditions.

FUTURE SCOPE

Further studies can be conducted on the combined effect of chitosan and 1-MCP on postharvest quality and shelf life coupled with MAP packaging of dragon fruits.

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Conflict of Interest. None.

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