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Application of Coverings and Storage at Different Temperatures on Dragon Fruits (*Hylocereus undatus*)

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Authors' contributions

This work was carried out in collaboration between all authors. Author JCC designed the study, performed the statistical analysis and managed the analyses of the study. Authors VAM collaborated with the crop and harvest. Authors LPM and RM collaborated in the analyses and study. Author EC supervised the researcher and the structure of the study. All authors read and approved the final manuscript.

Original Research Article

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ABSTRACT

Aims: This study aimed at evaluating the physicochemical characteristics of dragon fruits with application of different types of covering and submitted to two different refrigeration temperatures.
Study Design: The dragon fruits were taken, selected, washed, cleaned with a solution of Sodium hypochlorite 1%, dried and then, treated with coverings based on manioc starch at 2%, a jelly solution at 2% and a conservative solution (1% of ascorbic acid, 0.5% of citric acid, 0.7% of sodium chloride and 0.25% of calcium chloride) by immersion during 2 minutes. There was also a control treatment, that is, without treatment. After applying the coverings and drying the fruits, they were stored under refrigeration (8ºC±1ºC and

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13ºC±1ºC) and evaluated every 5 days, during 25 days of storage. The analyses carried out during the storage time were: pH, titratable acidity, soluble solids, ratio (SS/TA), coloration of pulp (parameters L*, C* and ºHue) and mass loss.
Place and Duration of Study: Laboratory of Food Biochemistry/State University of Maringá, in February 2013.
Methodology and Results: The fruits treated with jelly coverings and conservative solutions had the best appearance during storage under refrigeration at 8ºC. The parameters we evaluated showed oscillations in the average values, according to the period of time; however, there was not influence among the treatments.
Conclusion: It was possible to maintain the quality of fruits for longer periods with the application of coverings together with refrigeration temperatures.

Keywords: Post-harvest; coverings; conservation; quality.

1. INTRODUCTION

Dragon fruit is a cactus that belongs to genus *Hylocereus* and is native to the Americas [1,2]. This fruit comes from Tropical and Subtropical America and belongs to the group of fruit trees that are considered promising for cultivation [3].

A few decades ago, these plants were unknown; however, currently, they occupy a growing niche in the market of exotic fruits in Europe and have been searched for, not only due to its exotic appearance, but also because of its sensorial features [4].

They take part in one of the families of cactus that are easily recognized, with approximately 1600 species, being that more than 70% occur in xeric and semi-arid areas. Out of this number of species, approximately 130 are epiphytes that can be found in Neotropical forests and woods [5]. Fruits like dragon fruit and others, have significant levels of postharvest loss.

In developing or emergent countries, postharvest losses of all kinds of food can reach about 30% or more in production [6,7]. Therefore, maintaining fruit quality is essential, using postharvest storage techniques that tend to reduce respiratory rates, retard ripening and prevent physiological disorders. Water loss and natural decomposition of the fruit can be reduced in lower temperatures and also by changing the room environment, or even both, right after harvest [8].

Together with these factors, other strategies for postharvest improvement and quality control of fruits and vegetables, we can cite the application of Systems of Quality Guaranty, such as Good Agricultural Practices, Good Manufacture Practices, refrigeration and the use of coverings, whether edible or not [9].

Given the above, this study aimed at evaluating physicochemical characteristics of dragon fruits (*Hylocereus undatus*) during storage, with the application of coverings and different refrigeration temperatures.

2. MATERIALS AND METHODS

The fruits were harvested 45 days after fecundation in a rural property located in the city of Marialva, Paraná, Brazil, in February (crop 2013). The fruits were harvested randomly, conditioned in boxes made of industrial fiber. Later, they were taken to the Laboratory of Food Biochemistry of State University of Maringá (UEM), where they went through a selective process (fruits with physiological disorders and mechanical damages were removed), washing with neutral detergent, cleaning with solution of sodium hypochlorite 1% and drying with the aid of ventilation.

After being dried, the fruits were divided into four groups and submitted to four different coverings: (1) Control (T); (2) Solution with manioc starch at 2% (F); (3) Solution with jelly at 2% (J) and (4) Conservative Solution (SC) (1% of ascorbic acid, 0.5% of citric acid, 0.7% of sodium chloride and 0.25% of calcium chloride) [10]. After immersing the fruits into these solutions for 2 minutes, they were placed in trays with porous surfaces, where they remained until the coverings were completely dried and then, stored without packages under refrigeration temperatures. All of the treated fruits were divided into two groups: the first one being stored under refrigeration at 8ºC±1ºC (T1) - (maximum of 85% and minimum of 34% of relative humidity) and 13ºC±1ºC (T2) - (maximum of 65% and minimum of 46% of relative humidity). The fruits remained in storage for 25 days and were analyzed every 5 days.

The physicochemical analyses we carried out were: pH (determined by direct reading – potentiometric process - in pHmeter Hanna Instruments - Model HI 221 [11]; titratable acidity (TA) by titration with solution of NaOH 0.1M standardized and expressed in percentage (%) of organic acid [12]; soluble solids (SS), determined by digital refractometer (Pocket) PAL-1, brand ATAGO, expressed in ºBrix [11]; Ratio SS/TA, determined from the ratio between soluble solids and titratable acidity [12]; mass loss, made by the difference between initial and final weights in analytical scale BEL Engineering and expressed in percentage (%) [13] and pulp coloration, determined by colorimeter model CR-10, brand Konica Minolta, where we analyzed parameters L*, C* and ºHue [14].

The experimental design was in random blocks, in triplicates, and the data we obtained were submitted to Analysis of Variance (ANOVA). We also applied Tukey test to the averages at 5% of probability ($P<0.05$), by means of the statistical software Sisvar [15].

3. RESULTS AND DISCUSSION

For pH analysis, all of the fruits from the four different treatments (control, conservative solution, starch and jelly) and both temperatures (8ºC±1ºC, 13ºC±1ºC) had average results ranging between 4.41 and 5.77. However, during storage period, it was possible to observe a slight increase in these averages, for all treatments, as it is shown in Fig. 1.

Studies with dragon fruit had initial average values for pH of 4.60 and, on the last days of storage, averages between 5.32 and 5.80 for refrigerated fruits [16]. For three dragon fruit cultivars, had average pH values between 4.30 and 4.70 [17], and medias 4.75 to 4.91 [18]; these results are in accordance with the ones we obtained, which highlights that, most likely, the treatments did not affect pH during storage.

As for titratable acidity (TA) (Fig. 2), the averages decreased during storage time, for all temperatures and coverings. Despite some minor variations among the treatments, it was not possible to notice that there was difference in acidity due to the treatments (temperature and coverings). The results obtained for acidity agree with pH average values, because as organic acid amounts decrease, the concentration of H^+ also decreases in the pulp, which contributes to this raise in pH.

In general, the content of organic acid diminished as the fruits ripened, due to their use as substrate for respiratory processes or to convert to sugars [6]. Obtained average values for acidity of dragon fruit pulp between 1.85% and 0.17% of citric acid/100g of pulp [16], which were similar to the results found in this study. Other values for titratable acidity of two different breeds of dragon fruit: 0.35 to 0.45% of malic acid/100g of pulp [19]. While studying juice of two varieties of dragon fruit (*Hylocereus polyrhizus* and *Hylocereus undatus*), [20] obtained 3.40% and 3.30% of malic acid, respectively.

The average values for soluble solids have variations among the coverings and the refrigeration temperatures (Fig. 3), but both demonstrate a drop during the last storage days. With respect to the coverings, they did not present uniformity during the days of analysis. The numbers varied between 10.80ºBrix and 15.73ºBrix among all of the treatments.

Soluble solids indicate the amount, in grams, of solids dissolved in juice or pulp of fruits, and they usually grow, as fruits ripen [6].

In this study, we did not observe raises in the content of soluble solids. Since dragon fruit is considered a non-climacteric fruits [21], there may not be an increase in the amount of soluble solids in its pulp, because non-climacteric fruits usually only ripens fully when it is on the plant, that is, there is no increase in dissolved solids in the fruit pulp [6]. On the other hand, researches cite that fruits can be harvested at once, because they tend to ripen after harvest and be preserved for a longer time [1].

Values slightly lower for soluble solids were found in other studies, but with the same behavior of averages, in which case, the dragon fruits had 11.50ºBrix at initial time and, at the end of storage, for temperatures of 18ºC, 13ºC and 8ºC, the averages were 8.52, 8.72 and 10.90ºBrix, respectively [16]. For commercial dragon fruit, found 8.00ºBrix and for a variety from Cerrado, 13.50ºBrix [22].

Ratio soluble solids/titratable acidity is one of the means used to evaluate fruit flavor, being more representative than measuring acidity and amount of sugars [6]. This ratio is used as an indicator for the maturation degree of the raw-material [12], i.e., the higher this ratio, the higher the maturation degree and the better the taste. This relation for temperatures T1 and T2 (Fig. 4) demonstrated an independent increase of coverings during storage.

Other authors noticed an increase in this ratio soluble solids / titratable acidity in grapes 'Italia', treated with sodium alginate and stored under refrigeration, resulting in quality fruits with pleasant flavor [23].

Regarding mass loss (%) (Fig. 5), in all coverings, both temperatures had an increase during storage days, when the values varied from 2.44 to 4.67% on the first day of analysis, and from 7.59 to 14.27% on the last days of analysis

The main cause for mass loss in fruits and vegetables is water loss through transpiration, which give origin to important morphological alterations, unchaining alterations in color and texture of the fruit. These losses, when they reach 3% to 6%, are considered enough prejudicial to fruit quality [6]. In studies carried out with red dragon fruit, during storage for 25 days, under refrigeration (13ºC and 8ºC), the author obtained crescent averages of mass loss, which varied from 2.73% to 7.82% and from 2.35% to 5.32%, respectively [16]. A similar behavior was found in this study, increasing mass loss throughout the days of analysis.

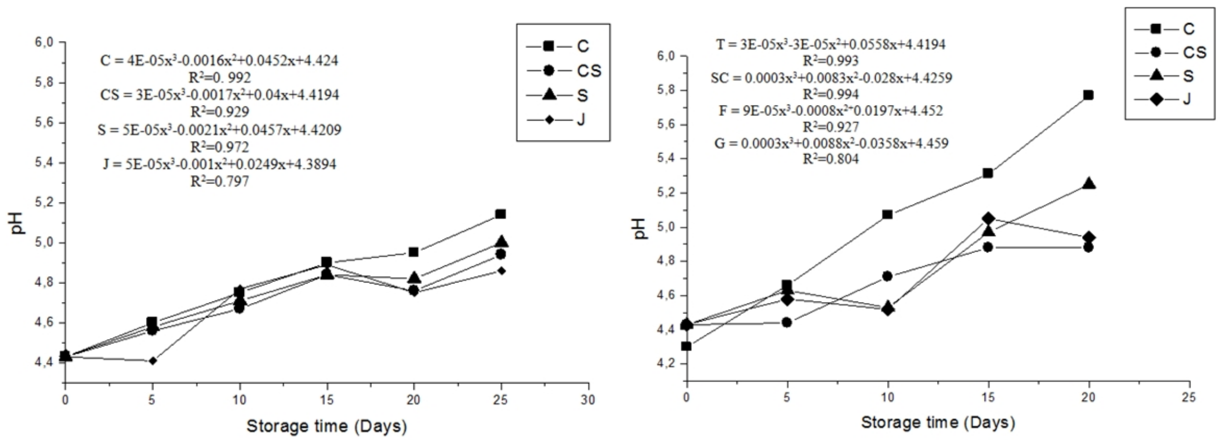

Fig. 1. pH values of pulp of dragon fruit (*Hylocereus undatus*) with coverings during storage under refrigeration temperatures of 8ºC ± 1ºC (A) and 13ºC ± 1ºC (B). Treatments: (C = Control; CS = Conservative Solution; S = Starch and J = Jelly)

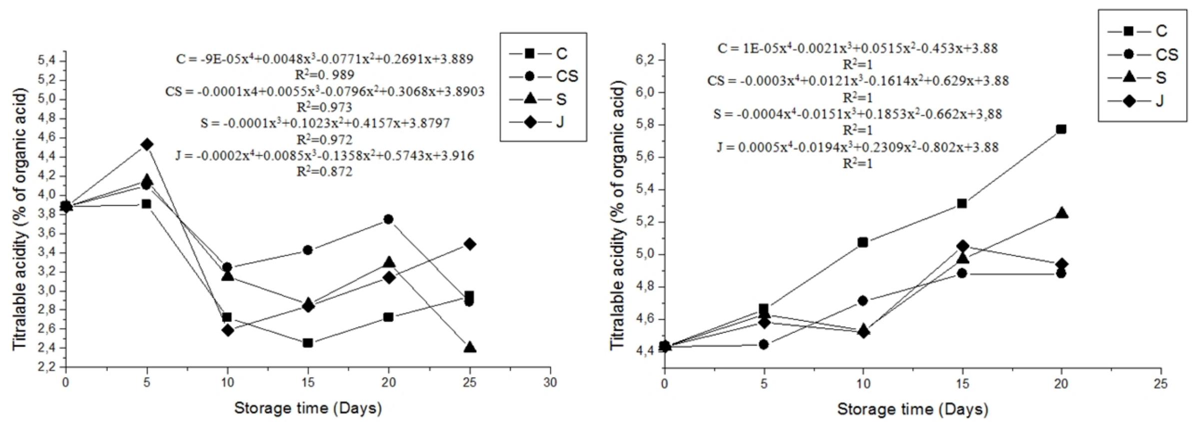

Fig. 2. Titratable acidity (% of organic acid) of dragon fruit (*Hylocereus undatus*) pulp with coverings during storage under refrigeration temperatures of 8ºC ± 1ºC (A) and 13ºC ± 1ºC (B). Treatments: (C = Control; CS = Conservative Solution; S = Starch and J = Jelly)

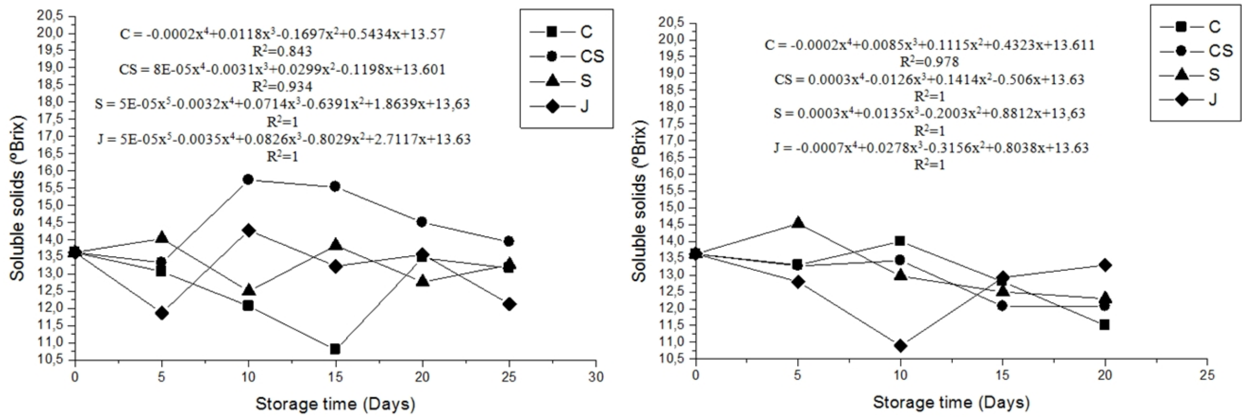

Fig 3. Soluble solids (ºBrix) of dragon fruit (*Hylocereus undatus*) pulp with coverings during storage under refrigeration temperatures of 8ºC ± 1ºC (A) and 13ºC ± 1ºC (B). Treatments: (C = Control; CS = Conservative Solution; S = Starch and J = Jelly)

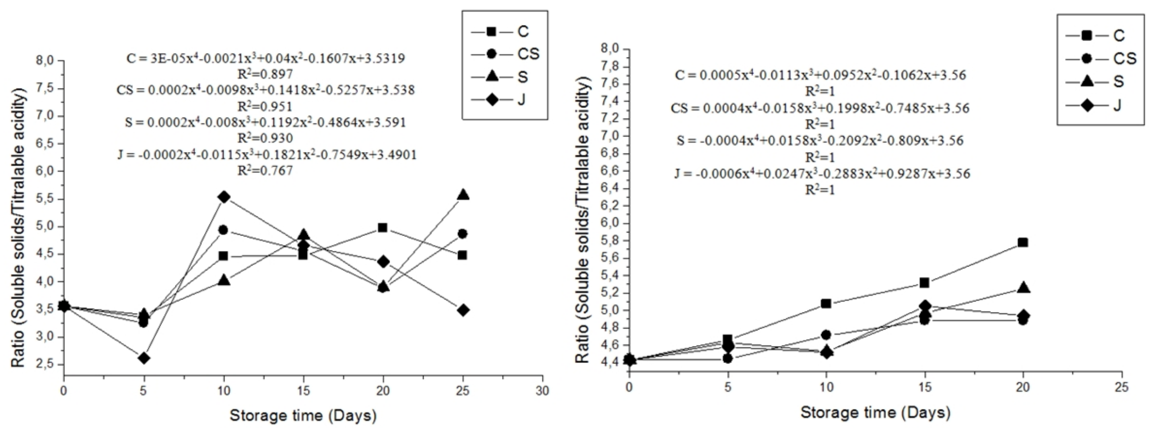

Fig 4. Ratio (Soluble Solids / Titratable Acidity) of dragon fruit (*Hylocereus undatus*) pulp with coverings during storage under refrigeration temperatures of 8ºC ± 1ºC (A) and 13ºC ± 1ºC (B). Treatments: (T = Control; SC = Conservative Solution; F = Starch and J = Jelly)

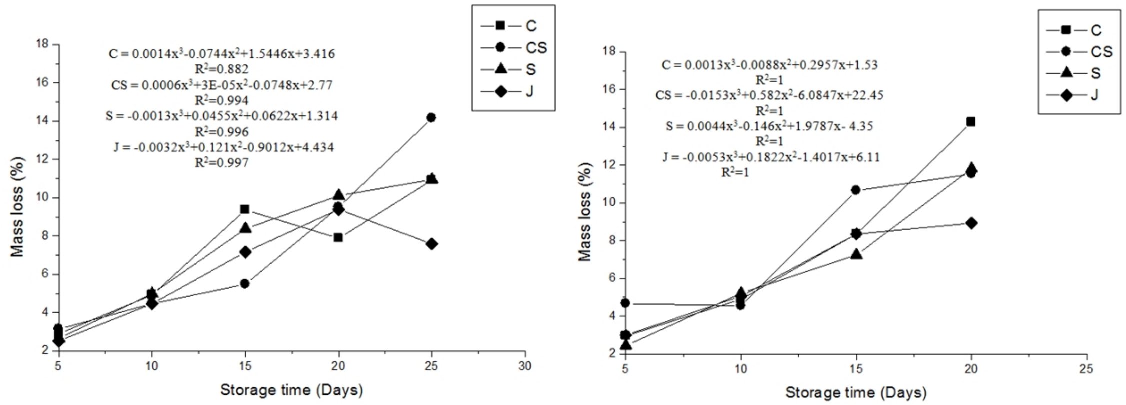

Fig. 5. Mass loss (%) of dragon fruit (*Hylocereus undatus*) pulp with coverings during storage under refrigeration temperatures of 8ºC ± 1ºC (A) and 13ºC ± 1ºC (B). Treatments: (T = Control; SC = Conservative Solution; F = Starch and J = Jelly)

Organic fruits of *Vaccinium ashei* Reade (Blueberry), treated with edible coverings based on manioc starch [13], did not show differences among the treatments. However, studies that evaluated the effect of coverings based on jelly at 20% on tomatoes stored for seven days at 23ºC showed that the fruits had a higher mass loss, when compared to the control treatment, which is a different result from this study, in which jelly coverings had the lowest mass loss during storage [24].

For coloration of dragon fruit pulp, we evaluated three parameters: L*, C* and ºHue. The evaluation of fruit color is an important parameter for producers and consumers, given that, through this feature, one can see whether the fruit reached ideal conditions for commercialization or not [25].

For parameter L* (Table 1), which measures luminosity, there were some oscillations during storage. There was a slight increase in values, indicating that luminosity was intensified in the fruit. It is important to highlight that on the fifth day of evaluation, for temperature 13ºC, the values were different from the other days.

Results found for parameter C* of pulp (Table 2) had crescent averages during storage, in spite of some variations among the values, pointing out the intensification of the most vivid colors. As for values of ºHue, we did not observe great differences between the days of analysis and the treatments (Table 3), that is, the numbers were constant during storage.

Table 1. Average values of coloration of dragon fruit (*Hylocereus undatus*) pulp (Parameter L*) during storage with coverings and under refrigeration at 8ºC (T1) and 13ºC (T2) (n=3)

	L*			
Time	T1			
	Control	Solution	Starch	Jelly
0	43.67±2.42cA	43.67±2.42bA	43.67±2.42cA	43.67±2.42bA
5	46.72±6.89bcA	44.17±0.49bA	46.67±3.20bcA	43.92±3.54bA
10	56.41±3.67aA	52.82±1.94aA	50.72±5.05abcA	53.65±4.30aA
15	50.80±1.82abcA	54.80±6.75aA	53.45±3.47abA	57.97±2.16aA
20	50.90±3.62abcA	57.22±1.91aA	55.10±5.79aA	55.57±6.61aA
25	54.10±4.20abA **	57.97±6.00aA	51.92±3.23abA	53.65±1.81aA
CV(%)¹	7.63			
Time	T2			
	Control	Solution	Starch	Jelly
0	43.67±2.42bA	43.67±2.42bA	43.67±2.42bA	43.67±2.42bA
5	23.95±0.97cAB	26.17±2.18cA	23.32±2.82cAB	20.85±2.95cB
10	52.80±1.52aA	52.97±2.52aA	48.87±4.21abAB	45.70±2.20bB
15	53.30±3.87aA	47.30±4.71bB	46.65±1.86abB	54.50±4.16aA
20	53.00±1.04aA **	54.00±1.40aA	51.85±1.98aA **	53.42±1.97aA
25	...	...	...	...
CV(%)¹	6.01			

**n = number of repetitions. *Different lowercase letters in the same column have significant differences between them by Tukey test (p<0.05). *Different capitalized letters in the same line and in the same temperature have significant differences between them, by Tukey test (p<0.05). cv (%)[1] = Coefficient of variation in percentage. (**) = Fruits with presence of physiological disorders. (…) = Treatments discarded due to rotten fruits*

In studies that determined color parameters in juices made of different types of Cactaceae, which is the family to which dragon fruit belongs, the genus *Opuntia* (*Opuntia ficus-indica*) was evaluated as for parameters L*, C* and ºHue in different pH. For values of L*, as pH increased, L* increased as well. This result is coherent to this study, because in pH evaluations it is possible to observe that it slightly increased during storage of fruits. As for parameters C* and ºHue in juice of three types of cactus with crescent pH concentrations, there were not different values for C* and ºHue in *Opuntia ficus-indica* cv. 'Rossa' and *Hylocereus polyrhizus* [20].

In this study, the increase in pH during storage time did not influence an increase or decrease of average numbers for ºHue, but for C*, we did not observe stable data.

Table 2. Average values of coloration of dragon fruit (*Hylocereus undatus*) pulp (Parameter C*) during storage with coverings and under refrigeration at 8ºC (T1) and 13ºC (T2) (n=3)

	C*			
Time	**T1**			
	Control	**Solution**	**Starch**	**Jelly**
0	6.77±0.85aA	6.77±0.85bA	6.77±0.85abA	6.77±0.85abA
5	7.65±1.12aA	6.60±0.40bAB	5.80±0.82bB	6.22±0.55bB
10	7.87±0.57aA	7.35±0.50abA	6.95±0.51abA	7.87±0.66aA
15	7.20±0.33aA	7.62±0.77abA	7.15±0.45abA	7.55±0.34abA
20	7.60±0.91aA	8.57±0.55aA	7.90±0.47abA	7.75±1.10aA
25	7.85±1.16aA **	8.05±0.46abA	7.82±0.40aA	7.80±0.55aA
CV(%)¹	9.72			
Time	**T2**			
	Control	**Solution**	**Starch**	**Jelly**
0	6.77±0.85aA	6.77±0.85abA	6.77±0.85aA	6.77±0.85abA
5	4.50±1.04bA	5.70±1.04bA	6.07±0.95aA	5.92±3.14bA
10	7.77±0.83aA	7.97±0.48aA	7.02±1.22aA	6.47±0.32bA
15	8.55±1.39aA	6.87±0.79abAB	6.10±0.48aB	7.85±1.05abAB
20	8.10±0.46aA**	8.17±0.30aA	8.00±0.53aA**	8.17±0.83aA
25	...	...	...	...
CV(%)¹	15.53			

**n = number of repetitions. *Different lowercase letters in the same column have significant differences between them by Tukey test (p<0.05). *Different capitalized letters in the same line and in the same temperature have significant differences between them, by Tukey test (p<0.05). cv(%)¹ = Coefficient of variation in percentage. (**) = Fruits with presence of physiological disorders. (…) = Treatments discarded due to rotten fruits*

Although the coverings exercised little influence on some parameters, such as pH, soluble solids and mass loss, they did not exercise such great influence on the other analyses. According to the results, coverings based on conservative solution and jelly were the ones that had the best appearance and quality of fruits during storage, guaranteeing fruits adequate for consumption for a longer period.

Table 3. Average values of coloration of dragon fruit (*Hylocereus undatus*) pulp (Parameter ºHue) during storage with coverings and under refrigeration at 8ºC (T1) and 13ºC (T2). (n=3)

	ºHue			
Time	**T1**			
	Control	**Solution**	**Starch**	**Jelly**
0	95.50±1.65aA	95.50±1.65aA	95.50±1.65aA	95.50±1.65aA
5	87.80±3.18bB	92.60±2.91aAB	95.16±3.02aA	91.02±2.03abcAB
10	88.35±3.92bA	90.67±1.84aA	90.05±3.06abA	85.42±3.91cA
15	88.30±7.69bA	91.25±3.95aA	91.47±0.80abA	90.15±1.09abcA
20	88.17±3.95bA	91.72±4.82aA	92.17±1.99abA	92.15±1.73abA
25	95.62±3.47aA**	92.27±1.69aAB	88.00±2.60bB	87.72±1.54bcB
CV(%)¹	3.31			
Time	**T2**			
	Control	**Solution**	**Starch**	**Jelly**
0	95.50±1.65aA	95.50±1.65abA	95.50±1.65abA	95.50±1.65abA
5	94.22±5.57abB	103.75±8.25aA	100.90±6.89aAB	101.67±7.11aAB
10	90.90±2.67abA	85.15±3.41cA	91.60±4.83bA	90.20±6.55bA
15	85.87±2.22bA	90.12±3.35bcA	90.90±5.41bA	89.62±2.37bA
20	92.05±0.75abA **	88.65±1.73bcA	89.67±1.73bA**	87.62±4.01bA
25	...	...	...	...
CV(%)¹	4.68			

**n = number of repetitions. *Different lowercase letters in the same column have significant differences between them by Tukey test ($p<0.05$). *Different capitalized letters in the same line and in the same temperature have significant differences between them, by Tukey test ($p<0.05$). cv(%)¹ = Coefficient of variation in percentage. (**) = Fruits with presence of physiological disorders. (…) = Treatments discarded due to rotten fruits*

4. CONCLUSION

The coverings we applied to dragon fruits were efficient, as for fruit conservation and appearance. Thus, the application of coverings and refrigeration temperature of 8ºC proportionated longer shelf life and maintained fruit quality, allowing longer period for commercialization.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

REFERENCES

1. Marques VB, Moreira RA, Ramos JD, Araújo NA, Silva FOR. Reproductive phenology of red pitaya in Lavras, MG. 2011;41(6):984-987.
2. Rebecca OPS, Boyce AN, Chandran S. Pigment identification and antioxidant properties of red dragon fruit (*Hylocereus polyrhizus*). 2010;9(10):1450-1454.
3. Moreira RA, Ramos JD, Marques VB, Araújo NA, Melo PC. Growth of red pitaya with organic and grainy bioclastic fertilization. Rural Science. 2011;41(5):785-788.
4. Le Bellec F, Vaillant F, Imbert E. Pitahaya (*Hylocereus* spp.): A new crop, a market with a future. Fruits. 2006;61(4):237-250.

5. Wallace RS, Gibson AC. Evolution and systematic. In: Cacti, Biology and uses. Nobel, P. (Editor). California: University of California Press; 2002.
6. Chitarra MIF, Chitarra AB. Pós-colheita de frutos e hortaliças: Physiology and handling. 2th Ed Lavras: UFLA; 2005.
7. Fao. Global food losses and food waste: Extent, causes and prevention. Rome; 2011.
8. Souza JP, Praça EF, Alves RE, Neto FB, Dantas FF. Influence of cold storage in combination with modified plastic films as mangoes "Tommy Atkins" atmosphere. Brazilian Journal of Tropical Fruits. 2002;24(3):665-668.
9. Cenci SA. Best Practices in Postharvest Fruits and Vegetables in Family Agriculture. In: Fenelon do Nascimento Neto. (Eds.). Basic Recommendations for the Implementation of Good Agricultural and Manufacturing Practices in Family Agriculture. 1th ed. Brasília: Embrapa Technological Information. 2006;67-80.
10. Fontes LCB, Sarmento SBS, Spoto MHF, Dias CTS. Conservation apple minimally processed with the use of edible films. Science and Food Technology. 2008;28(4);871-880.
11. AOAC. Association of Official analytical Chemists. Official methods of analysis. 16th ed. Gaitherburg: Publishedby AOAC International. 1997;2.
12. Lutz A. Métodos físico-químicos para análise de alimentos. 1th ed. São Paulo; 2005.
13. Stülp M, Clemente E, Oliveira DM, Gnas BBB. Conservation and quality of organic blueberry using edible coating the base of cassava starch. Brazilian Journal of Agroindustrial Technology. 2012;6(1):713-721.
14. Castro JC, Marsolla DA, Kohatsu DS, Hora RC. Storage and fruit quality of mango (*Mangifera indica L.*) treated with gibberellic acid. Agronomic Journal of Sciences. 2012;1(1):76-83.
15. Ferreira DF. Sisvar the system manual for statistical analyzes. Mines: UFLA; 2008.
16. Brunini MA, Cardoso SS. Quality of white pulp pitaias stored at different temperatures. Caatinga magazine. 2011;24(3):78-84.
17. Vaillant F, Perez A, Davila I, Dornier M, Reynes M. Colorant and antioxidante properties of red purple pitahaya (*Hylocereus* sp.). Fruits. 2005;60:3-12.
18. Fernandes LMS, Vieties RL, Cerqueira RC, Braga CL, Surtoli LF, Amaral JL. Traditional post-harvest organic fruit pitaya subjected to different doses of irradiation. Revista Biodiversidade. 2010;9:1.
19. Silva ACC, Martins ABG, Cavallari LL. Pitaya fruit quality depending on the time of pollination, the pollen source and the coloring of the covering. Brazilian Journal of Tropical Fruits. 2011;33(4):1162-1168.
20. Stintzing FC, Schieber A, Carle R. Evaluation of color properties and chemical quality parameters of cactus juices. European Food Research and Technology. 2003;216(4):303-311.
21. Zee F, Yen C, Nishina M. Pitaya (Dragon fruit, Strawberry pear). Cooperative extension Service. Fruits and Nuts; 2004.
22. Lima CA, Faleiro FG, Junqueira NTV, Cohen KO, Guimarães TG. Physicochemical characteristics, polyphenols and flavonoids em yellow fruits of species of commercial and pitaias native closed. Brazilian Journal of Fruits. 2013;35(2):565-570.
23. Miguel ACA, Dias JRPS, Albertini S, Spoto MHF. Postharvest grape 'Italy' coated films based on sodium alginate and stored under refrigeration. Science and Food Technology. 2009;29(2):277-282.
24. Oliveira TA, Leite RHL, Aroucha, EMM, Ferreira RMA. Effect of biofilm coating of tomato in appearance and weight loss during storage. Green Magazine. 2011;6(1):230-234.

25. Reis KC, Siqueira HH, Alves AP, Silva JD, Lima LCO. Effect of different sanitizers on the quality of strawberry cv. Oso Grande. Science and Food Technology. 2008;32(1):196-202.

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