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Shourov Dutta
Krishi Vigyan Kendra, Karbi Anglong, Assam Agricultural University, Diphu, Assam, India

Manoranjan Neog
Directorate of Extension Education, Assam Agricultural University, Jorhat, Assam, India

Corresponding Author
Shourov Dutta
Krishi Vigyan Kendra, Karbi Anglong, Assam Agricultural University, Diphu, Assam, India

Shelf life extension of dragonfruit (*Hylocereus sp.*) through some advanced techniques: A review

Shourov Dutta and Manoranjan Neog

Abstract
Dragonfruit (*Hylocereus sp.*) is an exotic fruit belonging to the Cactaceae family. The fruit has been recently hit the Indian markets and successfully grabbed the attention of almost every individual. The fruit is potentially rich in antioxidants and possesses many health benefits. Presently the fruit is fetching a good price but due to low shelf life one cannot store it for long. Therefore, a technique has to be developed through which it can be stored for a considerable period of time to fetch desired returns. Under such circumstances, a review has been carried out to collect and gather information on advancement techniques to extend the shelf life of dragonfruit to pave the way for the researcher to conduct studies and develop an ideal method to prolong the shelf life of the fruits during storage.

Keywords: dragonfruit, shelf life extension, pre treatment, packaging, post harvest

Introduction
Dragonfruit is gaining much attention and creating a buzz throughout the country these days. The fruit is native to the tropical forest regions of Mexico and Central and South America (Mizrahi *et al*., 1997) [21] belonging to the Cactaceae family. It is also popular by other names like *Pitaya* or *Pitahaya* (Le Bellec *et al.*, 2006) [18]. The plants grow up in tree trunk or concrete posts for support and are attached by aerial roots. The fruit reaches the best eating quality when harvested at ripe conditions (Chien *et al.*, 2007) [9]. Mostly, the fruits are red to pink in colour, while the juicy flesh ranges from white to magenta. The skin is covered with bracts or "scales" which make the fruit very attractive and unique in appearances. It is also referred as “Queen of the Night” or “Noble Woman” because of its beautiful night blooming flower. Basically, three types of Pitaya fruits are there. *Hylocereus undatus* (white-fleshed), *Hylocereus costaricensis* (red-fleshed) and *Hylocereus megalanthus* (yellow pitaya).
Dragonfruits are gaining attention due to its anti oxidative properties due to the presence of betacyanin content in it (Wybraniec and Mizrahi, 2004) [34]. Red fleshed dragon fruits were also reported to act as cancer chemopreventives, anti-inflammatory agents and antidiabetics along with it helps in reducing cardio vascular risks (Cos *et al.*, 2004) [10]. Moreover, it also acts against constipation and anaemia, helps in brain function, healthy hair and skin, improve appetite and maintain cholesterol (Gunasena *et al*., 2007) [14]. The fruits are low in calories and high in fibre, while the seeds contain high polyunsaturated fatty acids. It also improves eyesight and helps in curing hypertension, stomach and endocrine problems. Seeing the potentiality of the crop many of the farmers have already started cultivation of dragonfruit in India. Since the crop is new to the country, studies on post harvest are very scanty. Under such circumstances, a review on the available advanced techniques on enhancing the shelf life of dragonfruit has been studied and all the information gathered are brought together and discussed here in this study.

Post harvest losses in Dragonfruit
Study and research works regarding scientific management practices are going on this crop in the country. But, post harvest phase in the life cycle of the fruit also plays a key role in maintaining the quality of the fruit because it has been reported that during storage the quality degrades readily (Nerd and Mizrahi, 1999; Nerd *et al*., 1999; Chien *et al*., 2007) [24, 23, 9]. As per the reports of Nerd *et al*. (1999) [23]; Wall and Khan (2008) [33] and Chandran (2010) [8], the main post harvest problems in dragonfruit are mentioned to be mechanical injury, chilling injury, decay, and water loss. However, these losses can be prevented by harvesting the fruit when fully ripe and mature and careful handling after harvest (To *et al*., 2002) [32].

Visual quality, storage life, and marketability also get affected due to rapid shrivelling nature of the fruit (Jiang *et al*., 2002) [15]. Efforts are to be made to retard the transpiration because as soon as the fruit is detached from the fruit the shelf life gets shortened due to weight loss and desiccation through transpiration (Ariffin *et al*., 2009) [4]. However, frits subjected to high relative humidity are potentially more susceptible to decay (Shin *et al*., 2007) [29]. Another important post harvest loss reported was due to fungal infection such as *Rhizopus*, *Fusarium*, *Botryosphaeria* and *Colletotrichum* (Ali *et al*., 2013; Ma *et al*., 2009) [1, 19]. In addition, surface mould and mycotoxin infection has also been found to deteriorate the fruit quality during storage and transportation making it inappropriate for consumption (Pisani *et al*., 2015; De Corato *et al*., 2017; Pitt *et al*., 2013) [26, 11, 27].

Pre-treatment efforts to enhance the shelf life of dragonfruit

To *et al*. (2002) [32] made an attempt to extend the shelf life of dragonfruit when packed in a Modified Atmosphere Packaging (MAP) polyethylene bag with an oxygen transmission rate of 4 L/m^2/hour. In addition, they have also tried another arrangement where the fruits are packed in a polyethylene bag with 20 holes of 0.5 mm diameter and succeeded to extend the shelf life up to 28 days whereas, the check which was no use of any bag or polyethylene bag able to maintain its quality or freshness just merely up to 14 days only.

Punitha *et al*. (2010) [28] studied the retention of quality in dragonfruit in three different storage temperatures *viz.* low (6 °C), Intermediate (16 °C) and high (23±1 °C) at 85 to 90% relative humidity because temperatures have direct impact on fruit metabolic activities with reference to respiration (Fonseca *et al*., 2002) [13] and indirectly related to fruit texture, colour and other organoleptic properties (Marsh *et al*., 2004) [20]. From the results obtained by them, it was then evident that the peel colour and firmness retained maximum in the fruits stored at 6 °C. This might be probably due to the low temperature which restricted the enzyme synthesis and conversion of pigment (from chlorophyll to betacyanin) or colour change. On the other hand, low temperature might have slowed down the process of pectolytic enzyme activity (Tijskens and Dijk, 2000) [31] or turned the enzymes inactive (Perez *et al*., 2004) [25]. The TSS and total sugars also found to have a minimal change in case of the low temperature compared to the other storage temperatures, they added. Finally they concluded that, 6 °C is suitable for storing dragonfruits after harvest to extend the storage life.

Another study was conducted by Lau *et al*. (2008) [17], in which they have applied Heat treatment of 55 °C for 15 minute followed by bagging in polyethylene bags and then stored in 10 °C with 90% RH. This technique helped them to prolong the shelf life of dragonfruit up to 21 days whereas the fruit bagged in PE bags with holes only had a shelf life of 6-7 days when stored at 25-30 °C.

Zahid *et al*. (2013) [35] applied ethanolic extract of propolis with different concentrations like 0.25, 0.5, 0.75 and 1.0% followed by 70% ethanol for 2 minutes for uniform coating of the fruit surface. Control treatment taken was only dipping of fruits in the pure water. Finally, the treated fruits were air dried at ambient temperature (25 ± 2 °C) and stored at 20 ± 2 °C and 80 ± 5% RH for 20 days. Among the concentrations, 0.50% of ethanolic extract of propolis (EEP) was able to retain the quality parameters of the fruit like weight, texture, soluble solids concentrations (SSC), titrable acidity (TA) and phenolic compounds to the maximum. Whereas, comparatively higher values were found in case of the high concentration of EEP. Low SSC might be due to the formation of a semi-permeable film around the fruit which restricted ethylene production and maintained SSC content in the fruit (Kittur *et al*., 2001) [16]. In addition, they justified the loss of TA in higher concentrations by stating that ethylene production might have increased during storage which resulted in rise in respiration leading to low acidity level in the fruits (El-Anany *et al*., 2009) [12]. Finally, they concluded that 0.50% of EEP treatment not only retarded the respiration process but also triggered the biosynthesis of nutritional components.

Another attempt was made by Ali *et al*. (2014) [2] to maintain the quality of the dragonfruit during storage at 10 ± 2 °C and 80 ± 5% RH. The treatments used in the study were a double layer coating with 600 nm droplet size + 1.0% conventional chitosan and 1000 nm droplet size + 1.0% conventional chitosan. From the study, it came into light that the fruits treated with 600 nm droplet size (for 15 minute) and then dried overnight at room tempearure +1.0% conventional chitosan (for 5 minute) had promising results during the storage maintaining all the quality parameters like Soluble Solids Concentration, Titrable acidity, Total phenolic compounds, flavonoids, lycopene and total antioxidant activity.

Alvarez-Herrera *et al*. (2016) [3] tested three concentrations of 1-methylcyclopropene (0, 300, 600 mg l^{-1}) in vaporized form for 24 hours to extend the storage life of dragonfruits. Use of 1-MCP restricted the conversion of organic acids to sugars and maintained fewer Total Soluble Solids (TSS). Similarly, titrable acidity was found to have highest values in 600 mg l^{-1} of 1MCP treatment in comparison to the other treatments and control. This might be due to the delayed respiration which slowed down the dehydrogenase activity and finally maintained acidity level. Furthermore, the total carotenoids content showed increasing trend throughout the storage which indicated the 1-MCP treatment prolonged the storage period of the fruits. Lastly, they concluded that 1-MCP was found effective in reducing respiration and chlorophyll degradation leading to enhanced storage life up to 28 days when applied in vaporized form.

Mustafa *et al*. (2018) [22] applied four concentrations of salicylic acid (SA) (0.1, 1, 2 and 5mM) and methyl jasmonate (MJ) (0.01, 0.1, 0.2, and 0.5mM) at cold storage conditions (6 °C) to extend the storagability of dragonfruits. Results revealed that lower SA doses helped delaying of the ripening process and the MJ hormone enhanced the betacyanin and antioxidant activity.

In a study Chaemsanit *et al*. (2018) [7] applied peppermint oil adsorbed activated carbon at different concentrations (100–1000 µL L^{-1}) and placed in a storage box (25 ± 2 °C and 75 ± 5%RH). The treatment peppermint oil adsorbed activated carbon at concentration 700 µL L^{-1} was able to inhibit 100% surface mould and decay fungi for more than 14 days of storage whereas, the control started decaying just after 7 days.

Effect of packaging material on extending the shelf life

Packaging material plays a key role during storage period of the dragonfruits. Various packaging techniques have been tested by the researchers round the globe and have come out with positive results. Zee *et al*., (2004) [36] stored the fruit in perforated plastic bags at 4.5 °C and found the fruit stayed

fresh for 25-30 days whereas, the control treatment where the fruit was kept in room temperature had a shelf life of less than 10 days. In a study conducted by Chandran, 2010 [8], three stages of fruits are harvested (mature green, one week before fully ripe and fully ripe stage). The fruits are then packed in a clear wrap (0.8 micron) and stored at 03 (three) different temperatures *viz.* Low (6 °C), intermediate (16 °C) and high temperature (24 ± 1 °C). Fruits were then tested for quality parameters at the day of harvest, 7 days after storage and 14 days after storage. Results revealed that the wrapped fruits packed and stored at 6 °C remained firm and the peel colour was also maintained with no loss at 15 days of storage. But, the fruits at high temperature and intermediate temperature did not show the similar trend during the storage period. In both the temperatures (16 °C and 24 °C ± 1 °C) the fruits started to degrade soon along with the loss of quality. This might be due to the film packaging which helped in influencing the respiration rate and hindered the metabolic and microbial activities to retard enzyme degradation finally leading to prolonged shelf life (Catherine, 2002) [6]. According to the findings of Sutrisno and Purwanto (2011) [30], shelf life of dragonfruits can be extended up to 25 days when packed in Modified atmosphere containing 2–4% of O_2 and 6–8% CO_2 and stored at 10 °C. Castro *et al*. (2020) [5] conducted a study where the fruits were sleeved in polystyrene cups and packed in 50.8 micron polyethylene and polypropylene non perforated plastic bags and stored at 5 °C. The MAP fruits were found to have in excellent condition up to 6 weeks whereas the fruits without packaging lasted only up to 4 weeks. The polystyrene cups helped in maintaining the visual qualities of the fruit during the storage on the other hand the non packed fruits lost its quality earlier and exhibited yellowing and tip browning.

Conclusion

Finally, it can be concluded that there are plenty of advanced techniques either pre treatment or post harvest which can considerably prolong the shelf life of the fruits during storage. Since, the fruit is new for the farmers thereby many more research works on shelf life extension are to be taken in future days.

Reference

1. Ali A, Zahid N, Manickam S, Siddiqui Y, Alderson PG, Maqbool M. Effectiveness of submicron chitosan dispersions in controlling anthracnose and maintaining quality of dragon fruit. Postharv Biol Technol 2013;86:147-153.
2. Ali A, Zahid N, Manickam S, Siddiqui Y, Alderson PG. Double Layer Coatings: A New Technique for Maintaining Physico-chemical Characteristics and Antioxidant Properties of Dragon Fruit during Storage. Food Bioprocess Technol 2014;7(8):2366-2374.
3. Alvarez-Herrera JG, Deaquiz YA, Herrera AO. Effect of Different 1-methylcyclopropene Doses on the Postharvest Period of Pitahaya Fruits (*Selenicereus megalanthus* Haw.). Rev. Facultad Nacional Agrononia 2016;69(2):7975-7983
4. Ariffin AA, Bakar J, Tan CP, Rahman RA, Karim R, Loi CC. Essential fatty acids of Pitaya (dragonfruit) seed oil. J Food Chem 2009;114:561-564.
5. Castro A, Esguerra E, Franco RK. Modified Atmosphere Packaging and Low Temperature Storage of Red-Fleshed Dragon Fruit (*Hylocereus polyrhizus* (Weber) Britton & Rose). Philippine J Crop Sci 2020;45(1):1-12
6. Catherine NC. Microbial Control by Packaging: A Review. Crit Rev in Food Sci and Nutrition 2002;42(2):151-161.
7. Chaemsanit S, Matan N, Matan N. Effect of Peppermint Oil on the Shelf-life of Dragon Fruit during Storage. Food Control 2018;90:172-179.
8. Chandran S. Effect of film packing in extending shelf life of dragon fruit, *Hylocereus undatus* and *Hylocereus polyrhizus*. Acta Horticulturae 2010;875:389-394.
9. Chien PJ, Sheu F, Lin HR. Quality assessment of low molecular weight chitosan coating on sliced red pitayas. J Food Eng 2007;79:736-740.
10. Cos P, De Bruyne T, Hermans N, Apers S, Berghe DV, Vlietinck AJ. Proanthocyanidins in health care: current and new trends. Current Medicinal Chemistry 2004;10:1345-1359.
11. De Corato U, Salimbeni R, De Pretis A, Avella N, Patruno G. Antifungal activity of crude extracts from brown and red seaweeds by a supercritical carbon dioxide technique against fruit postharvest fungal diseases. Postharv Biol Technol 2017;131:16-30.
12. El-Anany AM, Hassan GFA, Rehab FMA. Effects of edible coatings on the shelf-life and quality of Anna apple (*Malus domestica* Borkh.) during cold storage. J Food Technol 2009;7:5-11.
13. Fonseca SC, Oliveira FAR, Brecht JK. Modelling respiration rate of fresh fruits and vegetables for modified atmosphere packages: a review. J Food Engineering 2002;52:99-119.
14. Gunasena HP, Pushpakumara DK, Kariyawasam M. Dragonfruit *Hylocereus undatus* (Haw.) Britton and Rose, Underutilized fruit trees in Sri Lanka, New Delhi, World Agroforestry Centre 2007, 110-42.
15. Jiang Y, Zhang Z, Joyce DC, Ketsa S. Postharvest Biology and Handling of Longan Fruit (*Dimocarpus longan* Lour.). Postharv Biol Technol 2002;26(3):241-252.
16. Kittur FS, Saroja NS, Habibunnisa Tharanathan RN. Polysaccharide-based composite coating formulations for shelf-life extension of fresh banana and mango. Eur Food Res Technol 2001;213:306-311.
17. Lau CY, Othman F, Eng L. The Effect of Heat Treatment, Different Packaging Methods and Storage Temperatures on Shelf Life of Dragon Fruit (*Hylocereus Spp*.). Research Centre Semongok Agriculture, Kuching, Sarawak. 2008, 1-16
18. Le Bellec F, Vaillant F, Imbert E. Pitahaya (*Hylocereus* spp.): a new fruit crop, a market with a future. Fruits 2006;61:237-250.
19. Ma TF, Yang B, Yu Y, Wang YW, Liu Y, Xu Z *et al*. Market disease pathogens detection of imported fruits in Shanghai. Agricultural Sciences in China 2009;8(9):1087-1096.
20. Marsh K, Attanayake S, Walker S, Gunson A, Boldingh H, MacRae E. Acidity and taste in kiwifruit. Postharvest Biol Technol 2004;32:159-168.
21. Mizrahi Y, Nerd A, Nobel PS. Cacti as crops. Horticultural Reviews 1997;18:291-319.
22. Mustafa MA, Ali A, Symour G, Tucker G. Treatment of Dragon Fruit (*Hylocereus polyrhizus*) with Salicylic Acid and Methyl Jasmonate Improves Postharvest Physico-chemical Properties and Antioxidant Activity during Cold Storage. Sci Horti 2018;231:89-96.

23. Nerd A, Gutman F, Mizrahi Y. Ripening and postharvest behaviour of fruits of two *Hylocereus* species (Cactaceae). Postharv Biol Technol 1999;17:39-45.
24. Nerd A, Mizrahi Y. The effect of ripening stage on fruit quality after storage of yellow pitaya. Postharv Biol Technol 1999;15:99-105.
25. Perez K, Mercado J, Valdez HS. Effect of storage temperature on shelf life of Hass avocado (*Persea americana*). Food Sci Technol Intl 2004;10:73-77.
26. Pisani C, Nguyen TT, Gubler WD. A novel fungal fruiting structure formed by *Aspergillus niger* and *Aspergillus carbonarius* in grape berries. Fungal Biol 2015;119(9):784-790.
27. Pitt JI, Taniwaki MH, Cole MB. Mycotoxin production in major crops as influenced by growing, harvesting, storage and processing, with emphasis on the achievement of Food Safety Objectives. Food Control 2013;32(1):205-215.
28. Punitha V, Boyce AN, Chandran S. Effect of Storage Temperatures on the Physiological and Biochemical Properties of *Hylocereus polyrhizus*. Proc. Southeast Asia Symp. on Quality and Safety of Fresh and Fresh Cut Produce. Acta Hort 2010, 875
29. Shin Y, Liu RH, Nock JF, Holliday D, Watkins CB. Temperature and relative humidity effects on quality, total ascorbic acid, phenolics and flavonoid concentrations, and antioxidant activity of strawberry. Postharv Biol Technol 2007;45:349-357.
30. Sutrisno SM, Purwanto EGM. Study of Dragon Fruit (Hylocereus costaricensis) Storage under Modified Atmosphere Packaging. Jurnal Keteknikan Pertanian. 2011;25(2):127-132.
31. Tijskens L, Van Dijk C. Enzyme activity and firmness in tomatoes. In: W.J. Florkowski, S.E. Prussia and R.L. Shewfelt (eds.), Fruit and vegetable quality: an integrated view, Technomic Publishing Inc., Lancaster Pennsylvania USA 2000, 73-80.
32. To LV, Ngu N, Duc ND, Huong HTT. Dragon fruit quality and storage life: Effect of harvesting time, use of plant growth regulators and modified atmosphere packaging. Acta Horticulturae 2002;575:611-621.
33. Wall MM, Khan SA. Postharvest quality of dragon fruit (*Hylocereus* spp.) after X-ray irradiation quarantine treatment. Hort Science 2008;43:2115-2119.
34. Wybraniec S, Mizrahi Y. Influence of perfluorinated carboxylic acids on ion-pair reversed-phase high-performance liquid chromatographic separation of betacyanins and 17-decarboxy-betacyanins. J Chromatography A 2004;1029:97-101.
35. Zahid N, Ali A, Siddiqui Y, Maqbool M. Efficacy of Ethanolic Extract of Propolis in Maintaining Postharvest Quality of Dragon Fruit during Storage. Postharv Biol Technol 2013;79:69-72.
36. Zee F, Yen CR, Nishina M. Pitaya (Dragon Fruit, Strawberry Pear); Cooperative Extension Service, College of Tropical Agriculture and Huan Resources, University of Hawaii at Manoa: Honolulu 2004, 1-3.