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EFFECT OF POSTHARVEST TREATMENT OF CALCIUM CHLORIDE AND POTASSIUM SULPHATE ON PHYSICAL PARAMETER AND SHELF LIFE OF DRAGON FRUIT (*HYLOCEREUS POLYRHIZUS* (WEB.) BRITTON AND ROSE)

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ABSTRACT

A study was conducted to evaluate the effect of post-harvest treatments using calcium chloride ($CaCl_2$) and potassium sulphate (K_2SO_4) on dragon fruit (*Hylocereus polyrhizus*) harvested at full maturity. Using a CRD with nine treatments (including a water control), fruits were stored at room temperature and assessed every four days over 12 days. Calcium chloride reduced firmness loss by inhibiting softening enzymes (PG and PME), while potassium sulphate minimized moisture loss and maintained freshness. The best results were observed with a combination of 2% $CaCl_2$ and 1% K_2SO_4, which effectively preserved quality and extended shelf life. Untreated fruits deteriorated the fastest.

***Key words*: Red-fleshed Dragon fruit, *Hylocereus polyrhizus,* Postharvest, $CaCl_2$, K_2SO_4 and Shelf life.

Introduction

Dragon fruit (*Hylocereus polyrhizus*), also known as pitaya, belongs to the cactus family and is extensively cultivated in tropical and subtropical areas. This fruit is originated from Mexico but this fruit is now grown extensively in southern China, Southeast Asia, and tropical and southern Central America. Dragon fruit can be used to make beverages, frozen desserts, preserves, and more. It is abundant in essential nutrients including calcium, phosphorus, fiber, vitamin B, vitamin C, antioxidants and carotene. Dragon fruit has remarkable health benefits, such as lowering blood pressure and cholesterol, controlling diabetes, preventing arthritis, improving heart health, supporting weight loss, minimising ageing, and strengthening the immune system. Major dragon fruit-growing countries are Vietnam, Colombia, Mexico, Costa Rica and Nicaragua, and to a lesser degree, cultivation occurs in Australia and Israel. The biggest import markets are Asia, particularly China, and the European Union (Le Bellec *et al*., 2006). In India, the cultivation of dragon fruit has seen rapid expansion, with key growing regions including Gujarat, Maharashtra, and north-eastern states. However, one of the challenges faced is its short shelf life due to issues like water loss, decay, bract yellowing, and chilling injury. Harvesting the fruit at varying maturity would give fruits of different physico-chemical and organoleptic quality. One important nutrient for plants is calcium, which plays an important role in cell processes, including preventing fruit senescence and softening (Barker and Pilbeam, 2007). Calcium chloride ($CaCl_2$) is known to strengthen cell walls and membranes, delaying senescence and maintaining fruit firmness. Applying potassium sulphate after harvest can help preserve fruit freshness and increase storage life by reducing moisture loss. Potassium sulphate (K_2SO_4), on the other hand, enhances fruit quality by improving colour, sugar content, and moisture retention.

Materials and Methods

The study was conducted at PG Laboratory, Department of Horticulture, School of Agricultural Sciences and Technology, Babasaheb Bhimrao Ambedkar University, located at Vidya Vihar on Raebareli Road in

Lucknow, Uttar Pradesh, India, during mid-October to the 1st week of November of 2024. Fruits were harvested from the Botanical Garden, Babasaheb Bhimrao Ambedkar University, which is situated at 26°46’18" N latitude, 80°55’10’’ E longitude, and 129 metres above mean sea level, is geographically inside the sub-tropical zone and is prone to harsh weather. All chemicals used in this experimentation were taken from the PG Laboratory of the Horticulture Department, Babasaheb Bhimrao Ambedkar University.

Post-harvest treatments

Well-matured dragon fruits (*Hylocereus polyrhizus*) of uniform size were harvested from the orchard. The fruits were washed thoroughly with running water to clean the dust. After being washed with tap water, the fruits were allowed to air dry and then soaked for five minutes in varying concentrations of potassium sulphate and calcium chloride and allowed to dry at room temperature (25°C). For the same duration of time, the control fruit was dipped in water. Fruits were stored in a dry, clean environment, and observations were made at every four-day interval.

The nine treatments were T_1 – Calcium chloride 1%, T_2 – Calcium chloride 2%, T_3 – Potassium sulphate 1%, T_4 – Potassium sulphate 2%, T_5 – Calcium chloride 1% + Potassium sulphate 1%, T_6 – Calcium chloride 1% + Potassium sulphate 2%, T_7 – Calcium chloride 2% + Potassium sulphate 1%, T_8 – Calcium chloride 2% + Potassium sulphate 2%, and T_9 – Control.

Qualities Measurement

Physical qualities like fruit weight, length of fruit, width of fruit, volume of fruit, specific gravity, physiological loss in weight, firmness, shelf life and total soluble solids were measured in 4-day intervals during the storage period.

The fruit weight was measured by the help of electronic weighing balance, and weight was expressed in grams. The length and width of fruit was measured by digital vernier calliper. The volume of fruit was recorded by the water displacement method with the help of a measuring cylinder. A penetrometer was used to record the firmness of fruits, and direct readings were obtained in terms of kg cm^{-2}. The shelf life of the fruits was determined by recording the number of days the fruits remained in good condition in storage.

Results

Fruit weight of dragon fruit under various treatments over time showed significant variation during the storage period. All treatments showed a progressive reduction in fruit weight from the 1st to the 12th day, indicating moisture loss due to respiration and transpiration processes common in post-harvest physiology.

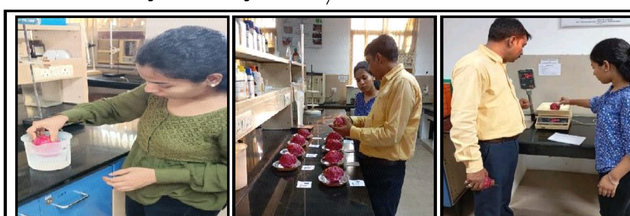
Perusal of Table 1 revealed that, among the treatments, T_7 consistently maintained the highest fruit weight, starting from 371.19 g on the 1st day to 283.96 g on the 12th day. This was followed closely by T_8 and T_2, which also demonstrated better retention of fruit weight compared to other treatments. Conversely, T9 recorded the lowest fruit weight across all days, ending with 237.24 g on the 12th day, indicating a greater rate of deterioration.

The fruit length was found to be significantly maximum in fruits under treatment T_7 (14.19, 14.14, 13.69, 13.24 cm) at the 1st, 4th, 8th, and 12th days of storage, respectively, which was at par with treatments T_2 and T_8, whereas minimum fruit length was found under the T_9 control (10.69, 9.75, 8.41, 5.18 cm) after the 1st, 4th, 8th, and 12th days of storage, respectively. The reduction in fruit size during the storage period might be due to the shrinking of fruits caused by transpiration.

The fruit width was found to be significant from the 1st to the 12th days of storage. The fruit width was found to be a significant maximum in fruits under treatment T_7 (9.77, 9.72, 9.43, 9.14 cm) at the 1st, 4th, 8th, and 12th days of storage, respectively, which was at par with treatment T_2, whereas minimum fruit width was found under T_9 – control (7.79, 6.64, 6.64, 6.64 cm) after the 1st, 4th, 8th, and 12th days of storage, respectively.

It is clear from the data that the volume of fruits showed a decreasing trend with increasing periods of storage (1st, 4th, 8th, and 12th days). On the 1st day of storage, the highest fruit volume was recorded in treatment T_7 (344.07 ml), followed by T_2 (331.52 ml) and T_8 (329.34 ml). The lowest volume was found in T_9 (312.95 ml). After 12 days of storage, T_7 maintained the highest fruit volume (287.99 ml), followed by T_2 (277.49 ml) and T_8 (275.65 ml), suggesting better retention of volume under these treatments. T_9 had the lowest volume (261.95 ml).

From day 1 to day 12, T_7 showed the maximum value



Dipping of fruit in chemical solution	Measuring fruit length and width with Vernier calliper	Observing weight loss after 4 days of storage

Plate 1: Photographs of Experiments.

Table 1: Effect of postharvest treatment of calcium chloride and potassium sulphate on physical parameter and shelf life of dragon fruit.

T	Physical Parameters on day of storage															
	Weight				Length				Width				Volume			
	1st	4th	8th	12th	1st	4th	8th	12th	1st	4th	8th	12th	1st	4th	8th	12th
T_1	344.64	327.40	310.20	263.66	13.32	12.67	11.62	10.57	8.62	8.42	7.99	7.56	323.84	310.90	301.20	271.05
T_2	355.56	337.80	320.00	272.01	14.16	13.98	13.27	12.55	9.63	9.53	9.23	8.93	331.52	318.30	308.30	277.49
T_3	329.28	312.80	296.30	251.89	12.75	12	10.85	9.70	8.28	7.84	7.20	6.56	321.27	308.40	298.80	268.90
T_4	319.78	303.80	287.80	244.62	11.06	10.2	8.94	5.77	7.96	7.05	5.93	4.81	315.12	302.50	293.00	263.74
T_5	322.15	306.00	289.90	246.43	12.02	11.14	9.86	6.90	8.10	7.53	6.66	5.79	316.57	303.90	294.40	264.96
T_6	335.98	319.20	302.40	257.02	12.91	12.21	11.11	10.01	8.60	8.35	7.90	7.45	322.01	309.10	299.50	269.52
T_7	371.19	352.60	334.10	283.96	14.19	14.14	13.69	13.24	9.77	9.72	9.43	9.14	344.07	330.30	320.00	287.99
T_8	353.56	335.90	318.20	270.47	13.46	13.28	12.70	12.12	9.07	8.94	8.60	8.26	329.34	316.20	306.30	275.65
T_9	310.12	294.60	279.10	237.24	10.69	9.75	8.41	5.18	7.79	7.06	6.09	3.94	312.95	300.40	291.10	261.95
S.E. (m)±	0.687	0.655	0.62	0.528	0.495	0.495	0.494	0.469	0.327	0.325	0.334	0.327	0.455	0.436	0.423	0.381
C.D. at @ 5%	2.057	1.963	1.857	1.582	1.481	1.481	1.478	1.405	0.979	0.973	1.001	0.979	1.361	1.306	1.268	1.142
C.V.	0.352	0.354	0.353	0.354	6.733	7.052	7.663	8.499	6.548	6.806	7.551	8.161	0.243	0.243	0.243	0.244

	Specific gravity				PWL				Firmness				SL
	1st	4th	8th	12th	1st	4th	8th	12th	1st	4th	8th	12th	Days
T1	1.06	1.05	1.03	0.97	0	5.03	5.20	15.02	5.73	3.75	2.69	1.63	11.00
T2	1.07	1.06	1.04	0.98	0	4.96	5.15	14.95	5.91	4.59	3.61	2.63	12.30
T3	1.02	1.01	0.99	0.94	0	5.01	5.25	15.06	5.50	3.27	2.08	0.89	9.90
T4	1.01	1.00	0.98	0.93	0	5.02	5.26	15.12	5.15	2.79	1.56	0.33	8.80
T5	1.02	1.01	0.98	0.93	0	5.01	5.26	15.10	5.23	2.79	1.59	0.39	9.30
T6	1.04	1.03	1.01	0.95	0	5.00	5.24	15.02	5.68	3.66	2.56	1.46	10.60
T7	1.08	1.07	1.04	0.99	0	4.93	5.11	14.82	5.94	4.82	4.02	3.22	12.80
T8	1.07	1.06	1.04	0.98	0	5.00	5.19	14.97	5.80	4.19	3.19	2.19	11.90
T9	0.99	0.98	0.96	0.91	0	5.03	5.28	15.27	4.92	2.42	1.13	0.14	7.80
S.E.(m)±	0.002	0.002	0.002	0.002	0	0.02	0.013	0.036	0.043	0.043	0.044	0.041	0.407
C.D. at @5%	0.007	0.007	0.007	0.007	0	0.06	0.038	0.106	0.13	0.13	0.13	0.124	0.136
C.V.	0.401	0.403	0.404	0.404	0	0.689	0.421	0.41	1.357	2.096	3.025	5.014	2.247

T: Treatments; **SL:** Shelf life

(1.08, 1.07, 1.04, 0.99), followed by T_2 and T_8, and T_9 continued to show the lowest specific gravity (0.99, 0.98, 0.96, 0.91), *i.e.*, indicating poor storage performance. The best treatments suggest that these treatments effectively reduced respiration or moisture loss.

The physiological weight loss values showed an increasing trend from the 1st day to the 12th day during storage. There was a significant difference observed among the treatments with respect to physiological weight loss at room temperature conditions. Among all the treatments, T_7 showed the minimum loss in physiological weight (0, 4.93, 5.11, 14.82%), and T_9 showed the maximum loss during storage compared to other treatments (0, 5.03, 5.28, 15.27%). It is evident from the present study that loss in weight was significantly affected by different post-harvest treatments throughout the storage period up to the 12th day of storage.

The firmness of dragon fruits showed a decreasing tendency with the increase in storage period. Fruits treated with T_7 chemicals recorded the highest value of firmness (5.94, 4.82, 4.02, 3.22), followed by T_2 (5.91, 4.59, 3.61, 2.63) and T_8 (5.80, 4.19, 3.19, 2.19), while the lowest firmness was recorded in T_9 – control (4.92, 2.42, 1.13, 0.14).

The data regarding the shelf life, which ranged from 7.8 days to 12.8 days. Maximum shelf life was recorded in treatment T_7- ($CaCl_2$) 2.0% + K_2SO_4 1% (12.8 days), which was followed by treatment T_2- ($CaCl_2$) 2% (12.3 days) and T_8 (11.9 days). Minimum shelf life was recorded in treatment T_9-control (7.8 days).

Discussion

Effect of Calcium Chloride and Potassium Sulphate on Firmness Retention

This present work found that postharvest calcium chloride ($CaCl_2$), especially in combination with potassium sulphate (K_2SO_2), greatly affected fruit firmness of red-fleshed dragon fruit during room temperature storage. T_7 (2% $CaCl_2$ + 1% K_2SO_4) treated fruits consistently showed higher firmness among the treatments and the control. Calcium is widely known to play a role in the maintenance of the firmness of fruits; it stabilises cell walls by cross-linking pectic substances and walls, forming calcium pectate, and also reduces the activity of cell wall degrading enzymes such as polygalacturonase and pectin methylesterase (PME) (Barker & Pilbeam, 2007; Chawla *et al*., 2018). This process induces partial softening and thus can be related to texture stability. These results are similar to previous findings in loquat (Akhtar *et al.*, 2010) and papaya (Singh *et al*., 2012), where postharvest calcium chloride dips were found to preserve fruit firmness and delay senescence.

Moisture Retention and Weight Maintenance

Potassium is an essential element for maintaining cell water balance and minimising water loss via transpiration in storage. K_2SO_4 treatments (T_7 and T_8) exhibit a lower PWL (physiological weight loss %) accompanied by a higher specific gravity throughout the storage period in this study. This indicates that the moisture retention and respiratory rates are improved under the treatments. Potassium also plays a role in membrane integrity and osmotic adjustment that provides for turgor and reduced tissue shrinkage (Mahajan & Dhatt, 2004; Awang *et al*., 2010). Better performance of $T_7$to reduce weight loss is consistent with previous reports in postharvest potassium treatments in tropical fruits.

Shelf-Life Extension

One important factor influencing marketability and postharvest success is shelf life. The T_7 treatment had a maximum shelf life of 12.8 days, which was significantly longer than the control's (7.8 days). The combined advantages of Ca^{2} and K ions in lowering respiration rate, postponing ripening, preserving membrane integrity, and limiting microbial decay are responsible for the increase in shelf life (Awang *et al*., 2010; Hussain *et al.*, 2012). Studies on ber (Jawandha *et al.*, 2008), custard apple (Netravati *et al.*, 2019), and guava (Rajput *et al*., 2008) all showed comparable improvements in shelf life after calcium treatments.

The most successful treatment was 2% $CaCl_2$ and 1% K_2SO_2 (T_7), which improved all important post-harvest quality characteristics, such as fruit weight, size, firmness, volume, specific gravity, and sweetness. This gives the idea that climacteric tropical fruits, such as dragon fruit, can benefit from the synergistic post-harvest application of calcium chloride and potassium sulphate, which can effectively delay senescence, reduce post-harvest physiological losses, and enhance storage behaviour.

Conclusion

The study showed that the post-harvest treatment of a combination of 2% calcium chloride ($CaCl_2$) and 1% potassium sulphate (K_2SO_2) on red-fleshed dragon fruit proved to be the best treatment (T_7) for maintaining fruit quality and shelf life during 12 days of storage. Fruits of treatment T_7 were able to maintain physical attributes like weight, size, volume, specific gravity, and firmness while maintaining minimum physiological weight loss. The untreated fruits, T_9-control, showed the most rapid deterioration in all quality parameters.

Therefore, T_7 emerged as the most effective post-harvest treatment for improving shelf life and maintaining the post-harvest quality of red-fleshed dragon fruit.

References

Akhtar, A., Abbasi N.A. and Hussain A. (2010). Effect of calcium chloride treatments on quality characteristics of loquat fruit during storage. *Pak. J. Bot.*, **42(1)**, 181-188.

Awang, Y., Ali M.S.M. and Ahmad S.H. (2010). Effect of calcium chloride postharvest dipping on quality of red-flesh dragon fruit (*Hylocereus polyrhizus*). *Acta Hortic*., **877**, 1473-1479.

Barker, A.V. and Pilbeam D.J. (Eds.). (2007). *Handbook of Plant Nutrition.* CRC Press.

Chawla, S., Devi R. and Veena J. (2018). Changes in physicochemical characteristics of guava fruits due to chitosan and calcium chloride treatments during storage. *J. Pharmacogn. Phytochem.*, **7(3)**, 1035-1044.

Dalvadi, A.C., Dodiya K.D., Bhad D.M., Chaudhari T. and Trambadiya R. (2017). Effect of chemicals on shelf life of *Syzygiumcuminii* Skeels cv. Local. *Agric. Sci. Dig.*, **38(1)**, 68-70.

Hussain, P.R., Meena R.S., Dar A. and Wani A.M. (2012). Effect of post-harvest calcium chloride dip treatment and gamma irradiation on storage quality and shelf-life extension of red delicious apple. *Journal Food Sci. Technol.*, **49(4)**, 415-426.

Jawandha, S.K., Randhawa J.S., Gill P.P.S. and Singh J. (2008). Effect of post-harvest treatment on storage quality in 'Umran' ber fruit. *J. Hortl. Sci.,* **3(1)**, 48-52.

Le Bellec, F., Vaillant F. and Imbert E. (2006). Pitahaya (*Hylocereus spp*.), A new fruit crop, a market with a future. *Fruits.,* **61(4)**, 237-250.

Mahajan, B.V.C. and Dhatt A.S. (2004). Studies on post-harvest calcium chloride application on storage behaviour and quality of Asian pear during cold storage. *J. Food Agric. Environ.,* **2(3)**, 157-159.

Mahitha, K., Manjula K. and Kalyani B. (2018). Postharvest application of calcium salts on fruit quality of guava during storage. *Int. J. Adv. Res. Ideas Innov. Technol.*, **4(5)**, 381-385.

Netravati, Suresh G.J. and Jagadeesh S.L. (2019). Effect of postharvest dip treatment of calcium chloride and wax on postharvest behaviour of custard apple fruits. *Acta Hortic.*, **80**, 541-548.

Patel, H.A., Patel M.J., Vasara R., Patel N.G. and Sutariy N.K. (2017). Effect of preharvest spray of calcium on bio-chemical parameters of sapota [*Manilkara achras* (Mill.) Forsberg] fruits cv. Kalipatti. *J. Pharmacogn. Phytochem.*, **6(5)**, 712-715.

Pawaskar, S.P., Pawar C.D., Bhuwad A.V., Tendulkar S.S., Dhumal R.D. and Kasture M.C. (2020). Effect of calcium chloride, polyethylene packaging and storage conditions on physical parameters of kokum fruits. *J. Pharmacogn. Phytochem.*, **9(2)**, 1157-1161.

Rajput, B.S., Lekhe R., Sharma G.K. and Singh I. (2008). Effect of pre and post-harvest treatments on shelf life and quality of guava fruits (*Psidium guajava* L.) cv. GWALIOR–27. *Asian J. Hort.*, **3(2)**, 368-371.

Shirzadeh, E., Rabiei V. and Sharafi Y. (2011). Effect of calcium chloride (CaCl2) on postharvest quality of apple fruits. *Afr. J. Agric. Res.*, **6(10)**, 2365-2368.

Singh, P., Kumar S., Maji S., Kumar A. and Yadav Y.C. (2012). Effect of calcium chloride on post-harvest changes in papaya fruits. *Asian J. Hort.*, **7(1)**, 113-117.

Wakchaure, G.C., Kumar S., Meena K.K., Rane J. and Pathak H. (2021). *Dragon fruit cultivation in India, Scope, constraints and policy issues* (Technical Bulletin No. 27).