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Efficacy of postharvest treatments on shelf life of ber cv. Gola under room temperature

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Abstract

The present investigation was carried out at PG Laboratory of the Department of Horticulture, CCS Haryana Agricultural University, Hisar during 2019-20 to find the effect of post-harvest treatments on shelf life of ber cv. Gola under room temperature. Fruits were treated with various post-harvest treatments and stored at room temperature up to 8 days. The reduction in loss in weight, decay loss and maximum fruit firmness, specific gravity, total soluble solids, colour, Sugars and organoleptic quality were maintained by *Aloe vera* 100% (pure juice) at room temperature. Based on present study, it is concluded that *Aloe vera* (pure juice) can be used effectively to enhance shelf life of ber without much deterioration of fruit quality.

Keywords: Ber, dip treatments, shelf life, quality, storage

Introduction

Ber (*Ziziphus mauritiana* L.) is an important fruit crop of arid and semi-arid regions, valued for its adaptability, low input requirement, and nutritional richness, particularly vitamin C and sugars. In India, ber is cultivated widely and used both for fresh consumption and processing into products such as jam, candy, and beverages. However, the fruit is highly perishable, with a shelf life of only 2-4 days under ambient conditions due to rapid physiological and biochemical deterioration, including moisture loss, softening, and microbial decay. Ber fruits are very nutritious and are usually eaten fresh. It contains good quantities of vitamins, minerals, and sugar. Ber fruits are good source of vitamin C (19.54 to 99.49 mg/100 g) (Koley *et al.*, 2011) [7]. These are used for making several delicious products like ber jam, dehydrated ber, ber murraba, ber candy and ready to serve beverages. The storage life of ber is extremely short *i.e.* hardly 2-4 days at ambient conditions thus early perishability of fruit poses a problem. The ber fruit respire and transpires continuously resulting in high weight loss, thus becoming susceptible to various diseases, which ultimately results into reduction of saleability. Due to increased metabolic activity of some enzymes, fruit quality is highly affected during storage resulting in deterioration of fleshy organs. Higher activity of cell wall degrading enzymes results in fruit softening, which subsequently leads to fruit decay. To enhance the storage quality of ber, post-harvest treatments can be alternatives to overcome post-harvest losses. Exogenous treatments inhibit the physiological degradation process, which curbs the fruit quality and also help in maintaining storage life. Post-harvest treatments such as calcium salts, edible coatings, organic acids, salicylic acid, and nitric oxide donors have been reported to delay senescence and maintain fruit quality by reducing respiration, ethylene production, and microbial activity. Nevertheless, limited information is available on the combined effects of post-harvest treatments and storage conditions on ber fruit. Therefore, the present study was undertaken to evaluate selected post-harvest treatments under ambient conditions for improving shelf life and quality of ber fruits.

Materials and Methods

Uniform and mature ber (*Ziziphus mauritiana* L.) fruits cv. 'Gola' were harvested from the orchard of Chaudhary Charan Singh Haryana Agricultural University, Hisar, India, during 2019.-2020. Fruits free from defects were washed, shade dried, and used for the experiment. The study was conducted in a Completely Randomized Design with three replications under room temperature (25 ± 2 °C).

Fruits were subjected to eight post-harvest treatments: lemongrass oil (0.1%), til oil (2%), *Aloe vera* gel (100%), salicylic acid (1 mM), calcium chloride (2%), citric acid (0.5%), sodium nitroprusside (1 mM), and an untreated control. Fruits were dipped in treatment solutions for 5 min, air dried, packed in corrugated fiberboard boxes, and stored under respective conditions. Observations were recorded at two-day intervals for physiological, biochemical, and sensory parameters, including physiological loss in weight, decay loss, firmness, colour, total soluble solids, titratable acidity, ascorbic acid, sugars, chlorophyll content, and free radical scavenging activity. Ascorbic acid content was determined by the method of A.O.A.C and Free radical scavenging activity (FRSA) was measured using the DPPH method. Data were analyzed using analysis of variance, and treatment means were compared at the 5% level of significance.

Results and Discussion

Loss in weight

The weight loss of fruits increased with the prolongation of storage period irrespective of the treatments applied. The

minimum loss in weight (5.21%) was recorded in *Aloe vera* 100% followed by calcium chloride 2% (5.43%). All the treatments were effective in checking the loss in weight over control (Table 1). The minimum loss in weight (5.21%) was recorded in *Aloe vera* 100% treated fruits, after 8 days of storage under room temperature. The increased weight loss in fruits was due to increased respiration and transpiration rate. However, minimum weight loss was observed in *Aloe vera* 100% treated fruits which might be due to presence of semi permeable barrier against oxygen, carbon dioxide and moisture and thus, helps in reducing respiration, oxidation reactions and water loss which, results into enhancement of shelf life of ber (Parven *et al.*, 2020)^[9]. Similar results were obtained by Mani *et al.* (2018)^[8] in ber. It is clear from the data that calcium chloride also proved itself effective in reducing weight loss and improving storage life of ber fruits by reducing softening of fruits and maintaining integrity of cell wall (Jain *et al.*, 2017)^[4]. Similar results were obtained by Singh *et al.* (2007)^[14] in ber and Bhoriya *et al.* (2018)^[3] in guava.

Table 1: Effect of post-harvest treatments on loss in weight (%) of ber at room temperature

Sr. No.	Treatments	Storage period (days)				Mean
		2	4	6	8	
T ₁	Lemongrass oil (0.1%)	1.85	5.77	8.72	14.65	6.20
T ₂	Til oil (2%)	1.57	5.10	8.08	14.17	5.78
T ₃	<i>Aloe vera</i> (100%)	1.38	4.32	7.03	13.30	5.21
T ₄	Salicylic acid (1 mM)	1.77	5.17	7.75	13.90	5.72
T ₅	Calcium chloride (2%)	1.55	4.67	7.33	13.60	5.43
T ₆	Citric acid (0.5%)	1.98	5.87	8.13	14.12	6.02
T ₇	SNP (1 mM)	2.12	5.58	8.37	15.50	6.31
T ₈	Control	2.40	5.88	9.77	17.12	7.03
Mean		1.83	5.29	8.15	14.5	
CD at 5% level of significance		Treatment (T) = 0.16 Storage period (S) = 0.13 T×S = 0.35				

Decay Loss

Data regarding decay loss (Table 2) depicted that the lowest decay loss (4.13%) was observed in *Aloe vera* 100%. This is because *Aloe vera* not only retards the rate of respiration and ripening process but also effectively inhibits the growth of pathogens like mould, fungi and bacteria which are responsible for rotting of fruits. This helps in maintaining the shelf life of fruits for longer period. Mani *et al.* (2018)^[8]

proposed that *Aloe vera* induce strong defence mechanism. Similar results were obtained by Parven *et al.* (2020)^[9] in papaya and Ahmed *et al.* (2009)^[1] in 'Arctic Snow' nectarine. In general, decay loss increased continually with the increasing storage duration irrespective of the treatments applied. Similar result for decay loss was observed by Singh *et al.* (2010)^[13] and Jain *et al.* (2017)^[4] in ber and Amanulla *et al.* (2017)^[2] in guava.

Table 2: Effect of post-harvest treatments on decay loss (%) of ber at room temperature

Sr. No.	Treatments	Storage period (days)				Mean
		2	4	6	8	
T ₁	Lemongrass oil (0.1%)	1.43	4.40	9.40	15.60	6.17
T ₂	Til oil (2%)	1.75	4.73	8.77	13.58	5.77
T ₃	<i>Aloe vera</i> (100%)	0.82	3.37	6.02	10.45	4.13
T ₄	Salicylic acid (1 mM)	3.68	5.52	9.60	13.67	6.49
T ₅	Calcium chloride (2%)	2.68	5.05	7.32	11.60	5.33
T ₆	Citric acid (0.5%)	3.07	5.65	9.85	15.30	6.77
T ₇	SNP (1 mM)	3.32	7.52	11.83	17.92	8.12
T ₈	Control	5.37	7.83	13.22	19.58	9.20
Mean		2.77	5.51	9.50	14.71	
CD at 5% level of significance		Treatment (T) = 0.58 Storage period (S) = 0.46 T×S = 1.30				

Fruit firmness

It is very clear from the present data (Table 3) that fruit firmness is significantly influenced by treatments. The maximum firmness (8.90 kg/cm²) was observed in *Aloe vera* 100% followed by calcium chloride 2% and the minimum

firmness was recorded under control. Decline in fruit firmness was observed in all the treatments during storage at room temperature. Mani *et al.* (2018)^[8] proposed that the decline in firmness was due to the dissolution of the polysaccharides like cellulose, xyloglucan and pectic

substances in the cell wall of middle lamella. *Aloe vera* showed the minimum decline rate, which might be associated with the reduction in respiration and transpiration rate up to a considerable extent. Thus, *Aloe vera* gave the

best results as compared to other treatments to retain better quality of ber fruit up to 8th days of storage. The interaction between treatments and storage was found significant.

Table 3: Effect of post-harvest treatments on fruit firmness (kg/cm²) of ber at room temperature

Sr. No.	Treatments	Storage period (days)					Mean
		0	2	4	6	8	
T ₁	Lemongrass oil (0.1%)	9.63	9.47	7.93	7.20	6.90	8.23
T ₂	Til oil (2%)	9.63	9.53	8.90	8.03	7.47	8.76
T ₃	<i>Aloe vera</i> (100%)	9.63	9.37	9.10	8.67	7.73	8.90
T ₄	Salicylic acid (1 mM)	9.63	9.40	9.00	8.40	7.50	8.83
T ₅	Calcium chloride (2%)	9.63	9.40	9.07	8.63	7.73	8.84
T ₆	Citric acid (0.5%)	9.63	9.43	8.57	7.27	6.77	8.33
T ₇	SNP (1 mM)	9.63	9.23	8.47	7.23	6.77	8.27
T ₈	Control	9.63	8.77	7.50	6.57	5.93	7.68
Mean		9.63	9.35	8.57	7.75	7.10	
CD at 5% level of significance		Treatment (T) = 0.25 Storage period (S) = 0.20 T×S = 0.55					

Total Soluble Solids

Total soluble solids of ber fruits was significantly influenced by treatments and storage period as shown in table 4. The maximum total soluble solids (14.7%) were maintained by *Aloe vera* 100% which was statistically at par with salicylic acid 1 mM (14.4%) during storage period. Similar results were obtained by Mani *et al.* (2018)^[8] in ber fruits. It was observed that total soluble solids increased up to 6th day and declined onwards, during storage among all

the treatments.

Similar pattern of total soluble solids were obtained by Singh *et al.* (2013)^[12], Jawanda *et al.* (2008)^[6] and Saran *et al.* (2004)^[10] in ber and Bhooriya *et al.* (2018)^[3] in guava fruit during storage. The increase in total soluble solids may be due to conversion of starch into monosaccharide or disaccharides. Total soluble solids might be less at end due to reduction in metabolic activities like senescence and respiration (Jain *et al.*, 2017)^[4].

Table 4: Effect of post-harvest treatments on total soluble solids (%) of ber at room temperature

Sr. No.	Treatments	Storage period (days)					Mean
		0	2	4	6	8	
T ₁	Lemongrass oil (0.1%)	13.5	13.6	14.3	15.3	14.7	14.3
T ₂	Til oil (2%)	13.5	13.7	14.3	15.3	14.5	14.3
T ₃	<i>Aloe vera</i> (100%)	13.5	13.8	15.2	15.7	15.3	14.7
T ₄	Salicylic acid (1mM)	13.5	13.6	14.5	15.3	15.0	14.4
T ₅	Calcium chloride (2%)	13.5	13.6	14.5	15.3	14.9	14.3
T ₆	Citric acid (0.5%)	13.5	13.6	14.4	15.3	14.7	14.3
T ₇	SNP (1mM)	13.5	13.7	14.2	15.4	14.7	14.3
T ₈	Control	13.5	13.8	14.2	14.4	13.7	13.9
Mean		13.5	13.7	14.5	15.3	14.7	
CD at 5% level of significance		Treatment (T)= 0.2 Storage period (S)= 0.1 T×S= 0.4					

Ascorbic Acid

The ascorbic acid content of ber fruits decreased with the advancement of storage period under all the treatments. The present data in table 5 showed that the maximum ascorbic acid (75.3 mg/100 g) content was recorded in calcium chloride 2% which was statistically at par with *Aloe vera* 100% and salicylic acid 1mM (74.0 mg/100 g) and the minimum (63.7 mg/100 g) was observed under control during storage. Decreasing trend of ascorbic acid might be

due to different level of oxidation in different treatments. Activities of oxidizing enzyme might have been reduced in treated fruits that resulted in higher level of ascorbic acid during storage (Singh *et al.*, 2010)^[13]. Similar reports were presented by Singh *et al.* (2019)^[11] in guava, Saran *et al.* (2004)^[10] and Mani *et al.* (2018)^[8] in ber. Higher retention of ascorbic acid in treated fruits may be attributed to reduced oxygen diffusion and lower respiration rate.

Table 5: Effect of post-harvest treatments on ascorbic acid (mg/100 g pulp) of ber at room temperature

Sr. No	Treatments	Storage period (days)					Mean
		0	2	4	6	8	
T ₁	Lemongrass oil (0.1%)	81.2	73.4	64.0	59.3	50.0	66.9
T ₂	Til oil (2%)	81.2	79.7	67.2	62.5	56.2	70.6
T ₃	<i>Aloe vera</i> (100%)	81.2	81.2	71.9	62.2	62.5	74.0
T ₄	Salicylic acid (1 mM)	81.2	79.7	75.0	67.2	60.9	74.0
T ₅	Calcium chloride (2%)	81.2	79.7	76.6	68.7	60.9	75.3
T ₆	Citric acid (0.5%)	81.2	75.0	70.3	62.5	54.7	70.0
T ₇	SNP (1 mM)	81.2	76.6	62.5	56.2	50.0	66.6
T ₈	Control	81.2	73.4	59.3	54.7	43.8	63.7
Mean		81.2	77.7	68.3	62.3	54.9	
CD at 5% level of significance		Treatment (T) = 3.26 Storage period (S) = 2.58 T×S = NS					

Organoleptic quality: The highest organoleptic score (6.8) was recorded in *Aloe vera* 100% followed by calcium chloride 2% (6.5) during storage up to 8th day as depicted in table 6. It was noted that organoleptic quality of fruits

decreased with the prolongation of storage period regardless of the post-harvest treatments. The present results are in agreement with Jain *et al.* (2017)^[4], Jawanda *et al.* (2012)^[5] and Saran *et al.* (2004)^[10] in ber.

Table 6: Effect of post-harvest treatments on organoleptic quality of ber at room temperature

Sr. No.	Treatments	Storage period (days)					Mean
		0	2	4	6	8	
T ₁	Lemongrass oil (0.1%)	8.0	6.7	5.7	4.7	3.7	5.7
T ₂	Til oil (2%)	8.0	7.3	6.3	5.3	4.3	6.3
T ₃	<i>Aloe vera</i> (100%)	8.0	8.0	7.0	6.0	5.0	6.8
T ₄	Salicylic acid (1 mM)	8.0	7.3	6.3	5.3	4.3	6.3
T ₅	Calcium chloride (2%)	8.0	7.7	6.7	5.7	4.7	6.5
T ₆	Citric acid (0.5%)	8.0	7.0	6.0	5.3	4.0	6.1
T ₇	SNP (1 mM)	8.0	7.0	6.0	4.7	4.0	5.9
T ₈	Control	8.0	7.0	4.7	3.7	2.7	5.2
Mean		8.0	7.3	6.1	5.1	4.1	
CD at 5% level of significance		Treatment (T) = 0.31 Storage period (S) = 0.2 T×S = 0.68					

Conclusion

Post-harvest treatments significantly affected the physiological and biochemical quality of ber fruits stored at room temperature. Overall, *Aloe vera* gel proved most effective in maintaining physical and biochemical quality of ber fruits during ambient storage, followed by calcium chloride and salicylic acid. These treatments significantly delayed ripening, reduced post-harvest losses, and extended the shelf life of ber fruits compared to untreated control fruits.

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