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Effect of Oxalic Acid on Postharvest Life of Ber (*Zizyphus mauritiana* Lam.) Fruits cv Banarasi Karaka

Ashok Kumar Meena, S. P. Singh, Anupam Tiwari, Sarvesh Singh, Neeharika Kanth

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Abstract A study was conducted to determine low cost treatment that may be readily adopted by farmers and exporters to extend the shelf life of ber. Hence, a study was designed to evaluate the oxalic acid (OA) treatments effectivity on ber fruit cv Banarasi Karaka regarding fruit quality during storage period of 13 days. Prior to storage, fruits were subjected to five minutes dipping in aqueous solution of OA at different concentrations (1.0, 2.0, 3.0 or 4.0 mmol) and stored at room temperature. To assess the effect of OA, different physiological and chemical analysis were taken out, including changes in weight loss, total soluble solids, acidity, ascorbic acid, decay percentage, microbial analysis and organoleptic evaluation (texture, flavor, taste and overall acceptability). Among different treatments, OA at 3.0 mmol concentrations was found better than other treatments and effectively decrease fruit weight loss, microbial infection and maintain the chemical composition of fruits during storage . Texture, flavor, taste and overall acceptability were registered with significantly highest scores in fruits treated with 3.0 mmol OA.

Keywords Ber, Banarasi Karaka, Oxalic acid, Quality, Postharvest life.

Ashok Kumar Meena, S. P. Singh, Anupam Tiwari*, Sarvesh Singh, Neeharika Kanth
Department of Horticulture, Institute of Agricultural Sciences, Banaras Hindu University, Varanasi 221005, UP, India
e-mail : uniquetiwari77@gmail.com
*Correspondence

Introduction

Ber (*Zizyphus muritiana* Lam.) is a hardy and profitable fruit crop. It grows successfully under rainfed condition with little inputs and care. Banarasi Karaka culivar is commercially grown in Northern India as a mid season crop. The storage life of ber fruits is extremely short and the rapid perishability of the fruits is a problem. At ambient temperature a shelf-life of 2—4 days is common. Due to the surplus of fruits in the local markets during peak season, a substantial quantity goes to waste, resulting in heavy postharvest losses [1]. Several kinds of edible chemicals, acidulants and reducing agents are in use for the extension of postharvest life of fruits. Oxalic acid, being an organic acid received much attention for food preservation [2]. Oxalic acid (OA) is not only a potential anti-browning agent, postharvest application to banana slices [3] and litchi fruits [4], has also been proved as a natural antioxidant in the natural and artificial safeguarding of oxidized materials from deterioration [5]. The application of oxalic acid has already been shown to induce systematic resistance against diseases caused by bacteria, fungi or viruses to affect antioxidant systems in plants [6]. Furthermore, oxalic acid is considered to be a natural antioxidant for artificial preservation of oxidized materials [5] and is under consideration to replace synthetic alternatives to minimize the risk of residues in bee products [7]. Keeping this in view, the present in vestigation was planned for standardization of oxalic acid dose for enhancing storage life of ber.

Materials and Methods

The experiment was conducted during 2014-15 at Post-Harvest laboratory, Department of Horticulture, Institute of Agricultural Sciences, Banaras Hindu University, Varanasi. Ber fruits were washed with distilled water to remove dust or any other residue. Solution of different concentration of oxalic acid viz. 1mM, 2mM, 3mM, 4mM was made. Four kg fruits were taken as sample per treatment and were dipped for five minutes. Control fruits were treated with distilled water only. After five minutes, the fruits were taken out and put on the blotting paper for removing moisture. Fruits were divided into two lots. One lot was divided in three replications. Each replication contained 1 kg fruits and kept in polythene bag. Second lot contained one kg fruits mainly for recording observations pertaining to physico-chemical comparison of the fruits. The packed fruits were stored at ambient temperature (-^{o}C±2^{o}C). various observations were recorded at 3 days interval and carried out over 13 days period. The titrable acidity and ascorbic acid contain were determined by earlier methods [8]. The TSS in the nectar was measured with the help of hand refractrometer. For determining the shelf life of fruits, fruits of each treatment were packed in perforated polythene bags and replicated thrice. The bags were stored at ambient temperature (17.6 ± 2^{o}C). The cumulative physiological loss in weight of the fruit in percent was calculated on the initial weight basis using the following formula.

$$\text{Physiological loss in wt (\%)} = \frac{\text{Initial weight} - \text{Final weight}}{\text{Initial weight}} \times 100$$

Total decay (rotten) fruits were separated from the lot of each treatment and observation was recorded on each subsequent date of observation. The percent decay loss was calculated using following formula.

$$\text{Decay loss (\%)} = \frac{\text{No. of decayed fruits}}{\text{No. of stored fruits}} \times 100$$

Observations on the pathogen was taken at 1 days, 4 days, 7 days, 10 days and 13 days in the laboratory of mycology and plant pathology department. Slides of decayed fruits were made and examined under simple microscope to identify the microbes causing rotting of fruits. The microbes were identified on their morphological make up. Organoleptic evaluation by 6 panelist was carried out using a nine-point hedonic scale (1 dislike extremely to 9 like extremely) water was also provided for the testers to rinse their month after each evaluation under a well lighted evaluation room [9].

Results and Discussion

Total soluble solids of fruits were significantly influenced due to different treatments. The maximum TSS content infruits were found with t (3mM OA). These results corroborate the findings of earlier worker who reported that treatment of OA influenced TSS content in litchi fruits [10] and mango [11]. The fruits stored over a period of 13 days showed that initially there was an increase in total soluble solids of fruits. The trend of gradual increase in TSS throughout the storage period of fruits was perceived. The increase in TSS during early days of storage might be owing to hydrolysis of polysaccharides and concentration of the juice of the fruits as a result of dehydration of fruit. Due to the hydrolysis of

Table 1. Effect of oxalic acid on chemical attributes of fruit during storage.

Parameters	TSS (^{O}Brix)					Acidity (%)					Ascorbic acid (mg/100g)				
Days to storage Treatments	0	4	7	10	13	0	4	7	10	13	0	4	7	10	13
T_1	12.80	13.44	13.95	14.25	12.33	0.252	0.201	0.161	0.135	0.114	93.83	83.36	74.63	63.13	68.91
T_2	12.80	13.85	14.50	14.89	13.23	0.252	0.194	0.170	0.145	0.125	93.83	86.70	80.40	74.20	77.11
T_3	12.80	14.20	14.89	15.55	14.40	0.252	0.225	0.200	0.179	0.169	93.83	87.53	83.20	79.36	81.10
T_4	12.80	13.66	14.10	14.39	13.12	0.252	0.220	0.197	0.174	0.159	93.83	85.56	80.20	75.50	80.23
T_5	12.80	13.18	13.51	13.67	11.30	0.252	0.214	0.171	0.128	0.080	93.83	82.66	70.50	59.16	65.20
CD at 5%	Treatment =0.010, Days =0.009, T ×D =00.20					Treatment=0.002, Days =0.002, T ×D =0.004					Treatment =0.11, Days=0.10, T × D = 0.23				

the fruits, the non-soluble fraction was converted into soluble fraction. The decrease in TSS on prolong storage may be due to increase in senescence process, which resulted in increased respiration rate. These results are in agreement with the findings of Pandey and Lal [12]. The initial increase might be due to the breakdown of starch and polysaccharides into simple sugars and organic acids and water loss during the subsequent storage. The decline in TSS level after the initial increase might be due to increase in senescence of the tissues [13], which can be attributed to a decrease in aril sucrose or due to utilization of sugar for respiratory process [14].

Treatment (3mM OA) reduced the acidity of ripe ber fruits in storage (Table 1) . Reduction in acidity might be due to increased TSS of the fruits. These results are in close conformity with the findings of Pandey and Lal [12] in litchi fruits. The acidity continuously decreased in all the treatments with the increase in duration of storage. Decreasing trend of acidity upon prolonged storage of apple has been reported by Dong et al. [15]. One of the reason for decrease in acid content may be likely its utilization in respiration. The titratable acidity might have decreased rapidly due to rapid ripening process in the pulp. The titratable acidity was more decreased probably due to rapid utilization of acid of the fruit pulp in respiration process [16].

Application of different concentrations of oxalic acid significantly increased the ascorbic acid content of ripe ber fruits. T_3 (3mM OA) was found to be more effective in this regard than others. Similar results have also been reported by Kant et al. [17] and Sayyari et al. [18]. Ascorbic acid continuously decreased with increase in duration of storage in all the treatments. The decrease may be due to the degradation of ascorbic acid into dehyanoscorbic acid. The rate of decreasing of ascorbic acid was found lesser in treated fruits as compared to controlled fruits.

Experimental results indicated that there was a beneficial impact of different treatments on physiological weight and decay loss of fruits (Table 2). The maximum physiological weight loss was observed under control after storage of 13 days. This is attributed to the retardation of respiration and enzymatic activities responsible for disorganization of cellular structure. The decay loss was also significantly reduced by different treatments and it was minimum with T_3 (3mM OA). These findings corroborate the results of Zheng et al. [4] and Marboh et al. [10]. Less spoilage by oxalic acid treatment might be due to the effect of fungistatic action of oxalic acid [19, 20] . Acidic conditions on the surface of the peel make it difficult for most fungi to develop [21].

Sensory evaluation of any commodity decides its quality and the preference of the consumer towards that commodity. Experimental results indicated that there was variable impact of treatments on organoleptic parameters of the fruits. The cosumer preference drastically decreased after storage of 10 days. Treatment (3mM OA) was judged to be the best. These findings are in close conformity with the results of Zhang et al. [2]. This is mainly attributed to inhibition of the enzymatic activities

Table 2. Effect of oxalic acid on physiological weight loss, decay losses and overall acceptability of fruit during storage.

Parameters	Physiological weight loss (%)					Decay loss (%)					Overall acceptability by consumer				
Days to storage	0	4	7	10	13	0	4	7	10	13	0	4	7	10	13
Treatments															
T_1	0	1.52	3.02	4.80	7.91	0	1.10	1.79	3.20	5.01	8.70	7.81	6.95	6.51	6.11
T_2	0	1.26	2.41	3.85	6.85	0	0.05	1.11	2.01	2.84	8.70	8.15	7.31	6.80	6.30
T_3	0	1.06	1.96	3.52	6.40	0	0.03	0.08	1.51	2.21	8.70	8.30	7.59	7.25	6.51
T_4	0	1.38	2.65	4.35	7.15	0	0.08	1.25	2.38	3.15	8.70	7.96	7.11	6.61	5.80
T_5	0	1.67	3.51	5.73	9.05	0	2.01	4.91	8.50	13.20	8.70	7.50	6.31	6.01	4.11
CD at 5%	Treatment = 0.012, Days = 0.010, T × D = 0.023					Treatment = 0.11, Days = 0.010, T × D = 0.022					Treatment = 0.11, Days = 0.10 T × D = 0.23				

responsible for pericarp browning, which is manifested as better red pericarp color. This finding substantiates the work done by Saengnil et al. [22] on litchi cv Hong Huay. Although, acid treatment causes a slight penetration of the acid into the flesh, the eating quality of the fruit remains undisturbed.

Experimental results indicated that there was a beneficial impact of different treatments on pathogenic infestation of fruits. The maximum infestation was observed under control after storage of 13 days. Treatment (3mM OA) significantly reduced infestation of different pathogens. These findings corroborate the results of Zheng et al. [4] and Kant et al. [17].

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