



Effect of pre-harvest sprays of ca, zn and b on biochemical parameters of ber (*Zizyphus mauritiana* lamk.) during storage

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Abstract: An experiment was conducted in *Research Fruit Orchard* at K.N.K. College of Horticulture, Mandsaur (M.P.). Ten treatments consisting of foliar spray of Calcium Nitrate, Zinc Sulphate, Borax and control sprayed twice. First spray was done during November 2013 at initial stage of fruiting and second spray is repeated after 3 weeks of first spray. Harvested fruits were kept in plastic trays and stored at ambient room temperature and relative humidity. The treated fruits were analyzed for Total soluble solids (^oBrix), acidity (%), sugars (%) [Total, reducing and non reducing sugar] at 0, 3rd, 6th and 9th day of storage. Among the treatments T₅ (ZnSO₄ @ 0.4%) has proved best pre-harvest application for maintaining the chemical parameters for transportation and storage of *ber* cv. Seb in terms of TSS and sugars. It may therefore, be recommended that the pre-harvesting application of (ZnSO₄ @ 0.4%) improve the storage life and quality at ambient room temperature.

Key words: Pre-harvest sprays, Calcium, Zinc, Boron, Storage, biochemical parameters, Ber

Introduction

Ber (*Zizyphus mauritiana* Lamk.) the poor man's apple is one of the most ancient and common fruit indigenous to India and belongs to family Rhamnaceae. Cultivated globally because of its nutritive value having good amount of vitamins C, A and B complex. In general, the fruits contain 85.9% moisture, 12.8% carbohydrates, 0.8% protein, 0.8% iron, 0.1% fats, 0.03% each of calcium and phosphorus, and 70 I.U. vitamin A/100 g with an energy value of 55 calories/100 g. Yamadagni and Bose (1985). Among various fruit crops, ber is gaining popularity with the growers because of its high yield, good returns and suitability for growing under drought and wasteland conditions. The storage life of ber fruit is very short, hardly 2-4 days at ambient conditions is that a greatest problem for its successful transportation and marketing. Major ber producing areas in Madhya Pradesh are Jabalpur, Chhindwara, Hosangabad, Sagar, Dhar, Khandwa, Kargone, Ratlam, Mandsaur, Mandla and Dindori. Scanty of study has been made on shelf-life of ber with the exogenous application of micro-nutrients and plant growth regulators (Meena *et al.*, 2013). However, large quantity of fruit is lost after harvest due to inherent bio-chemical changes. In recent years, Plant growth regulators have been used for improving the quality, delaying deterioration in storage and thereby increasing shelf life of various fruit crops including Ber. Calcium compounds extend the shelf life of several fruit by maintaining firmness, minimizing the rate of respiration, protein breakdown and disease incidence (Gupta *et al.*, 1987). Borax and zinc sulphate are known to play a crucial role in growth, development, quality and storage of fruits (Jayachandran *et al.*, 2005; Singh *et al.*, 2007 and Rajput *et al.*, 2015). Therefore, an attempt has been made in the present study to prolong the shelf life of ber fruit with the spray of calcium nitrate, zinc sulphate and borax on plant.

Materials and Methods

To examine the pre-harvest sprays of Calcium Nitrate, Zinc Sulphate and Borax on the shelf life of ber, an experiment was conducted at the *Instructional cum research fruit orchard*, K.N.K. College of Horticulture, Mandsaur (M.P.) during the year 2013-14. The meteorological data such as maximum and minimum temperature (28.4°C and 14.4°C), Relative humidity (55% and 26%) were recorded. The experiment comprised of 10 treatments consisting of foliar spray of T₀ served as control only water, T₁ 1.0%, T₂ 1.5% and T₃ 2.0% were Calcium Nitrate solution, T₄ 0.2%, T₅ 0.4% and T₆ 0.6% are of ZnSO₄ solution, T₇ 0.2%, T₈ 0.4% and T₉ 0.6% are of Borax solution. The spray of these micronutrients concentrations done twice (at initial stage of fruiting) during November 2013 and second sprays is repeated after 3 weeks of first spray. Fresh, fully mature and uniform fruits were taken from seven year old treated trees of ber (*Zizyphus mauritiana* Lamk.) cv. Seb. After harvesting, fruits were kept in plastic trays and stored at ambient room temperature and relative humidity. The treated fruits were analyzed for Total soluble solids (^oBrix) and acidity (%) as per methods given by A.O.A.C. (1970) and sugars (%) [Total, reducing and non reducing sugar] as per methods given by Nelson (1944). The collected data were analyzed through statistical procedure suggested by Panse and Sukhatme (1985).

Results and Discussion

It is evident from Table 1 that there was increase in total soluble solids content of ber fruits up to 3rd day of storage in all the treatments including control and thereafter significant variation seen in treated and untreated fruits. Maximum TSS content (19.76 °Brix) of ber fruits were recorded by the spray of T₅ (0.4% Zinc sulphate), whereas minimum (14.15 °Brix) under T₁ (1.0% Calcium nitrate) at the end of storage. The increase of TSS during storage may be due

Table-1: Effect of different doses of chemicals on total soluble solids (°Brix), acidity (%), reducing sugar (%), non reducing sugar (%) and total sugars (%) of ber fruits during storage (at 0, 3rd, 6th, 9th days)

Treat- ments	Total soluble solids				Acidity				Reducing sugar				Non reducing sugar				Total sugar			
	0	3 rd	6 th	9 th	0	3 rd	6 th	9 th	0	3 rd	6 th	9 th	0	3 rd	6 th	9 th	0	3 rd	6 th	9 th
T ₀	20.63	19.28	19.27	18.81	0.14	0.12	0.11	0.10	2.23	2.63	2.60	2.37	4.60	5.32	3.88	3.30	5.69	4.86	6.73	6.51
T ₁	14.94	14.22	14.20	14.15	0.14	0.15	0.12	0.10	3.02	3.24	2.90	2.72	6.89	6.69	6.85	6.36	9.55	9.77	9.47	9.27
T ₂	15.69	15.06	15.15	14.87	0.21	0.19	0.19	0.17	4.32	4.15	4.14	3.16	4.56	2.90	4.14	3.83	8.30	9.10	7.99	9.11
T ₃	16.48	16.28	19.39	14.72	0.20	0.17	0.16	0.14	3.22	3.13	3.12	2.88	2.72	2.59	3.71	5.17	6.75	7.14	6.87	8.41
T ₄	20.09	19.91	19.82	18.75	0.15	0.12	0.12	0.11	3.38	3.23	3.23	2.65	4.70	4.84	4.71	4.36	7.77	8.40	7.86	7.37
T ₅	20.82	20.11	19.98	19.76	0.21	0.21	0.20	0.18	4.90	4.26	4.43	3.81	8.51	8.30	7.89	7.44	11.51	10.73	10.11	9.32
T ₆	20.18	20.06	19.37	19.12	0.14	0.12	0.12	0.11	3.77	3.29	3.39	3.22	3.27	4.16	4.18	3.71	7.06	6.75	8.22	9.89
T ₇	20.08	19.75	16.31	15.24	0.14	0.14	0.14	0.13	4.32	3.50	3.28	3.20	3.19	2.76	4.88	4.11	8.88	8.41	7.57	6.78
T ₈	16.86	16.47	16.25	15.58	0.16	0.12	0.13	0.13	2.69	3.74	3.33	3.32	4.77	4.63	5.45	4.15	7.48	7.40	8.68	6.71
T ₉	18.22	17.68	17.88	16.80	0.16	0.12	0.12	0.11	3.52	4.22	3.23	3.42	3.68	3.62	4.50	3.93	7.82	7.47	8.60	7.79
S.Em.±	0.21	0.16	0.03	0.06	0.007	0.007	0.006	0.005	0.10	0.03	0.04	0.19	0.09	0.04	0.04	0.05	0.09	0.04	0.11	0.12
CD at 5%	0.62	0.48	0.09	0.18	0.020	0.020	0.018	0.014	0.30	0.08	0.10	0.56	0.27	0.11	0.11	0.14	0.25	0.12	0.33	0.36

T₀: Control (water spray); T₁: Calcium Nitrate @ 1.0%; T₂: Calcium Nitrate @ 1.5%; T₃: Calcium Nitrate @ 2.0%; T₄: Zinc sulphate @ 0.2%; T₅: Zinc sulphate @ 0.4%; T₆: Zinc sulphate @ 0.6%; T₇: Borax @ 0.2%; T₈: Borax @ 0.4%; T₉: Borax @ 0.6%; Significantly (p<0.05)

to the breakdown of complex polymers into simple substances by hydrolytic enzymes, that may have further metabolized during respiration and level got decreases during subsequent storage. More retention of TSS during storage might be due to decrease in physiological loss in weight and decay loss which resulted into slow degradation of soluble contents of the fruits. In some treatments the acidity initially increased on 3rd day storage. The initial increase might be due to the start of anaerobic respiration, thereafter the decrease in acidity during storage could be attributed to the conversion of acids into salt and sugars by the enzymes particularly invertase. Since the juice became concentrated (loss of moisture during storage), the increase in per cent acidity was obvious. The maximum (0.18%) acidity during storage was observed in fruits treated with T₅ (0.4% zinc sulphate) against the minimum (0.1%) under control. Similar improvement and retention of TSS has also been reported by Mrinalini *et al.* (1998), Singh *et al.* (2007) and Goswami *et al.* (2013) in guava and Bhowmick *et al.* (2013) in mango.

Acidity was found minimum (0.3%) reduction in acidity during storage in T₅ (0.4% zinc sulphate) followed by T₂ (1.5% Calcium nitrate) against the maximum (0.4%) under control. The decrease in acidity with zinc sulphate has also been reported in guava by Mrinalini *et al.* (1998); Wali *et al.* (2006); Singh *et al.* (2007); Goswami *et al.* (2013) also reported in mango by Bhowmick *et al.* (2013). The maximum reducing sugar (3.81%) was recorded in 0.4% zinc sulphate (T₅) treatment, whereas the minimum (2.37%) in control (T₀), non-reducing sugar (7.44%) was recorded maximum in 0.4% zinc sulphate (T₅) treatment, whereas the minimum (3.30%) in control (T₀), total sugar (9.32%) was recorded maximum in 0.4% zinc sulphate (T₅) treatment, whereas the minimum (6.51%) in control (T₀) treatment on 9th day of storage respectively. Similar result are also reported by Vishwakarma *et al.* (2014) in ber, Mrinalini *et al.* (1998); Singh *et al.* (2007); Goswami *et al.* (2013) in guava and Bhowmick *et al.* (2013) in mango. The initial increase may be due to the conversion of starch into simple sugars and decrease later on could possibly be due to utilization of these sugars in respiration during storage. Application of chemicals retained higher sugar content over control during storage. They might have reduced

the rate of respiration and delayed the onset of senescence. In the present investigation It may therefore, be recommended that the pre-harvesting application of (zinc sulphate @ 0.4% fruits maintained the fruit quality in terms of sugar, total soluble solids (TSS), and acidity during storage on 9th day of storage.

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