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Influence of post-harvest application of ethrel on bio-chemical parameters of papaya (*Carica papaya* L.) cv. Madhu Bindu

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Abstract

An experiment was carried out at Department of Horticulture, B. A. College of Agriculture, Anand Agricultural University, Anand during *khariif* 2017. The objective of this work was to evaluate the effects of various concentrations of Ethrel (500 mg/l, 750 mg/l, 1000 mg/l and 1250 mg/l) on biochemical aspects such as TSS ($^{\circ}$ Brix), acidity (%), total sugars (%), reducing sugar (%), non-reducing sugar (%), ascorbic acid content (mg/100g) and total carotenoids (mg/100g). The observations were recorded at 2, 4, 6 and 8 days after storage. From the experiment it was clear that the Overall performance of the above characteristics was found the best when the fruits were treated with 1000 mg/l ethrel followed by 750 mg/l ethrel.

Keywords: Post-harvest, ethrel, bio-chemical parameter, papaya, carotene

Introduction

Papaya (*Carica papaya* L.) belonging to the family *caricaceae*, is one of the most important fruits cultivated throughout the tropical and subtropical regions of the world. Presently, papaya cultivation is spread over tropical and sub-tropical part of the world covering 32° N and 32° S on the globe. Top twenty papaya cultivating countries are distributed in Asia (India, Bangladesh, Thailand, Indonesia, Philippines, Malaysia and China), Africa (Nigeria, Ethiopia, Congo, Kenya, Ivory Coast and Mozambique), Latin and Central America (Brazil, Mexico, Venezuela, Colombia and Cuba). Some developed countries like USA (Hawaii), Australia, South Africa and Taiwan also cultivate papaya. India is supposed to be the largest producer of papaya in the world. Papaya occupies 1.8% of total fruit crop area and 6.3% of total fruit production in India. It occupies a cultivated area of 133.4 (000 ha) with an annual production of 5699.00 (000 MT) and productivity of 42.3 (MT/ha). Papaya is an abundant source of carotene (2020 I.U./100g), precursor of vitamin A. Papaya fruits are used for the treatment of piles, dyspepsia of spleen and liver, digestive disorders, diphtheria and skin blemishes. Ethrel is an ethylene-releasing chemical, which can be used to improve fruit color development and stimulates ripening process of the fruit. Fruit ripening is a genetically programmed stage of development overlapping with senescence (Watada *et al.*, 1984) [1]. Aqueous solution of ethrel is stable below pH 3.5. Above pH 3.5, the hydrolysis of ethrel begins with the release of free ethylene along with chloride and phosphate ions. On dipping the mature fruits in ethrel, it enters into the fruit cells, releases ethylene and hastens the ripening process. Ethrel has been found very effective growth regulator in ripening and improving fruit quality in many climacteric fruits. Keeping in view the usefulness of ethrel treatments in fruits as revealed by various scientists, the present study was aimed to evaluate the effectiveness of postharvest immersion in different ethrel concentrations on the postharvest quality attributes of papaya fruit kept at ambient temperatures.

Materials and Methods

The present investigation entitled "Influence of post-harvest application of ethrel and paper wrapping on papaya (*Carica papaya* L.) cv. Madhu Bindu" was carried out at Laboratory of the Department of Horticulture, B. A. College of Agriculture, Anand Agricultural University, Anand (Gujarat) during the year 2017. The fruits of papaya cv. Madhu Bindu which were

physiologically mature and have attained the full size, light green with tinge of yellow at apical end were used for the study. The fruits were selected on the basis of uniformity, maturity, size and shape. The experiment was laid out in Completely Randomized Design (CRD) with five treatments and three replications.

The fruits were washed with clean water and dipped for five minutes in the following concentrations of Ethrel solution. i.e. control (E₀), 500 ppm (E₁), 750ppm (E₂), 1000 ppm (E₄) and 1250 ppm (E₅). After each treatment, the fruits were air dried at ambient temperature for 30 minutes in an attempt to reduce possible chemical injury. The control fruits were dipped for five minutes in the distilled water without using the ethrel solution. The number of fruits treated under each treatment was ten, out of which four fruits were examined for their chemical composition in three replications at the interval of 2 days, 4 days, 6 days and 8 days after storage. The data collected for different observations were subjected to statistical analysis by adopting 'Analysis of variance' techniques as described by Steel and Torrie (1980).

Results and Discussion

The results obtained from the present investigation are summarized below:

Total Soluble Solids (°Brix)

The data revealed that during the entire storage period ethrel exerted their significant effects on total soluble solids of fruit. The maximum Total Soluble Solids (TSS) at 2nd and 4th day of storage period (8.42 and 9.85 °Brix) were found when papaya fruits were treated with ethrel 1250 mg/l (E₄), while

maximum total soluble solids were found at 6th and 8th day storage period (11.78 and 10.48 °Brix). The significantly minimum TSS (6.40, 6.78, 7.82 and 7.50 °Brix) was observed with E₀ treatment (no ethrel). The increased TSS might be due to rapid loss of water from fruits and conversion of starch into sugar at faster rate observed in ethrel treated fruits as compared to the control. These results corroborate well with the Das *et al.* (2011) [2] in mango cv. Alphonso, Chauhan *et al.* (2012) [3] in orange fruits, Dhillon and Mahajan (2011) [4] in pear fruits, Kulkarni *et al.* (2004) [5] in mango cv. Neelum, Singh *et al.* (2012 c) [6] in mango cv. Amrapali, Mahajan *et al.* (2010) [7] in banana cv. Grand Naine, Sachin Patil *et al.* (2009) [8] in mango and Madhavi *et al.* (2005) [9] in sapota.

Acidity (%)

The data revealed that at 2nd, 4th, 6th and 8th day of storage period different concentration of ethrel shows significant effect on the acidity. Minimum acidity (0.36, 0.26, 0.17 and 0.10%) was found when papaya fruits were treated with ethrel 1250 mg/l (E₄) at 2nd, 4th, 6th and 8th day of storage period, respectively which was at par with ethrel @ 1000 mg/l (E₃) treatment at 4th day (0.13%) of storage period. Due to ethrel treatment, there is an increase in the membrane permeability which permits the acid stored in cell vacuole to respire at faster rate, and it resulted in to the reduction of acidity during ripening. In conformity of these findings Anwar *et al.* (2008) [10] in mango fruits packed in corrugated cardboard packaging, Kulkarni *et al.* (2004) [5] in mango fruits cv. Neelum, Mahajan *et al.* (2010) [7] in banana cv. Grand Naine, Singh *et al.* (2012 c) [6] in mango cv. Amrapali and Madhavi *et al.* (2005) [9] in sapota cv Pala.

Table 1: Influence of post-harvest application of ethrel on total soluble solids and acidity (%) of papaya fruits cv. Madhu Bindu

Treatments	Total Soluble Solids (°Brix)				Acidity (%)			
	2 day	4 day	6 day	8 day	2 day	4 day	6 day	8 day
E ₀ : No ethrel	6.40	6.78	7.82	7.50	0.49	0.32	0.24	0.16
E ₁ : Ethrel @ 500 mg/l	6.93	7.33	9.62	9.24	0.46	0.31	0.23	0.13
E ₂ : Ethrel @ 750 mg/l	7.60	7.90	10.08	9.63	0.44	0.30	0.21	0.13
E ₃ : Ethrel @ 1000 mg/l	8.10	8.58	11.78	10.46	0.41	0.27	0.20	0.12
E ₄ : Ethrel @ 1250 mg/l	8.42	9.85	8.53	8.14	0.36	0.26	0.17	0.10
S.Em. ±	0.12	0.05	0.16	0.12	0.01	0.00	0.00	0.00
C.D. at 5%	0.34	0.15	0.46	0.35	0.02	0.01	0.01	0.01

Table 2: Influence of post-harvest application of ethrel on Ascorbic acid (mg/100g pulp) and Total sugar (%) of papaya fruits cv. Madhu Bindu

Treatments	Ascorbic acid (mg/100g pulp)				Total sugar (%)			
	2 day	4 day	6 day	8 day	2 day	4 day	6 day	8 day
E ₀ : No ethrel	24.80	33.32	36.35	29.55	9.23	13.74	15.66	13.46
E ₁ : Ethrel @ 500 mg/l	26.77	34.68	40.91	32.95	9.63	14.41	17.56	14.77
E ₂ : Ethrel @ 750 mg/l	29.32	35.88	42.94	35.12	10.04	15.61	18.84	15.44
E ₃ : Ethrel @ 1000 mg/l	32.07	38.43	45.89	36.95	10.70	16.98	20.24	17.42
E ₄ : Ethrel @ 1250 mg/l	34.78	41.75	38.61	32.20	11.27	18.48	17.26	14.12
S.Em. ±	0.83	1.11	0.63	0.53	0.13	0.36	0.40	0.34
C.D. at 5%	2.44	3.26	1.85	1.57	0.39	1.05	1.17	1.00

Table 3: Influence of post-harvest application of ethrel on reducing sugar (%) and Non-reducing sugar (%) of papaya fruits cv. Madhu Bindu

Treatments	Reducing sugar (%)				Non-reducing sugar (%)			
	2 day	4 day	6 day	8 day	2 day	4 day	6 day	8 day
E ₀ : No ethrel	1.00	1.14	2.09	0.93	8.23	12.61	13.57	12.53
E ₁ : Ethrel @ 500 mg/l	1.11	1.26	2.32	1.24	8.52	13.15	15.24	13.53
E ₂ : Ethrel @ 750 mg/l	1.19	1.37	2.59	1.48	8.85	14.25	16.25	13.96
E ₃ : Ethrel @ 1000 mg/l	1.30	2.37	3.18	2.26	9.40	14.61	17.07	15.16
E ₄ : Ethrel @ 1250 mg/l	1.39	2.92	2.21	1.03	9.89	15.56	15.05	13.09
S.Em. ±	0.03	0.04	0.06	0.02	0.14	0.36	0.42	0.34
C.D. at 5%	0.10	0.11	0.17	0.07	0.40	1.07	1.22	1.01

Table 4: Influence of post-harvest application of ethrel on Total carotenoids (mg/100 g pulp) of papaya fruits cv. Madhu Bindu

Treatments	Total carotenoids (mg/100 g pulp)			
	2 day	4 day	6 day	8 day
E ₀ : No ethrel	1.74	2.30	2.80	1.93
E ₁ : Ethrel @ 500 mg/l	1.84	2.37	2.85	2.00
E ₂ : Ethrel @ 750 mg/l	1.97	2.45	2.95	2.13
E ₃ : Ethrel @ 1000 mg/l	2.16	2.62	3.07	2.24
E ₄ : Ethrel @ 1250 mg/l	2.28	2.84	2.70	1.85
S.Em. ±	0.01	0.01	0.02	0.01
C.D. at 5%	0.04	0.04	0.06	0.04

Ascorbic acid (mg/100g pulp)

Ascorbic acid were significantly differs by different concentrations of ethrel. The maximum ascorbic acid at 2nd and 4th day of storage period (34.78 and 41.75 mg/100g pulp) were found when papaya fruits were treated with ethrel @ 1250 mg/l (E₄), while at 6th and 8th day of storage period (45.89 and 36.95 mg/100g pulp) were found when papaya fruits were treated with ethrel @ 1000 mg/l (E₃). The significantly minimum ascorbic acid (24.80, 33.32, 36.35 and 29.55 mg/100g pulp) was observed with E₀ (no ethrel) treatment at 2nd, 4th, 6th and 8th day of storage period. A reduction in ascorbic acid content with the subsequent prolongation of storage might be due to rapid oxidation phenomenon of organic acid in later stage of storage Orzolek and Argel, (1974) [12]. Results on similar line were also observed by Sing *et al.* (2012a) [11] in papaya and Das *et al.* (2011) [2] in mango cv. Alphonso.

Total sugar (%)

The data revealed that at 2nd, 4th, 6th and 8th day of storage period different chemicals shows significant effect on the accumulation of total sugar. The maximum total sugar (%) at 2nd and 4th day of storage period (11.27 and 18.48%) was found when papaya fruits were treated with ethrel @ 1250 mg/l (E₄). While at 6th and 8th day of storage period significantly the maximum total sugar (20.24 and 17.42%, respectively) was observed with ethrel @ 1000 mg/l (E₃). While, minimum total sugars (%) at 2nd, 4th, 6th and 8th day of storage period (9.23, 13.74, 15.66 and 13.46% respectively) were found in E₀ (no ethrel) treated fruits. The increase in total sugar content during ripening could be attributed to hydrolysis of starch into sugars. Similar result was also recorded by Sing *et al.* (2012a) [11] in papaya, Kulkarni *et al.* (2004) [5] in mango fruits cv. Neelum, Singh *et al.* (2012 c) [6] in mango cv. Amrapali and Tapre and Jain (2012) [13] in banana var. Robusta.

Reducing sugar (%)

Similar trends was observed in case of reducing sugar (%) at 2nd, 4th, 6th and 8th day of storage period, different chemicals shows significant effect on the accumulation of reducing sugar. The maximum reducing sugar was noted in ethrel @ 1250 mg/l treatment during 2nd and 4th day of storage (1.39 and 2.92%, respectively) while (3.18 and 2.26%) at 6th and 8th day of storage which was at par with E₃ at 2nd day (1.30%) of storage period. Minimum reducing sugar was noted in E₀ (no ethrel) treatment during 2nd, 4th, 6th and 8th day of storage (1.00, 1.14, 2.09 and 0.93%, respectively). The increase in the level of reducing sugar was possibly due to acceleration of ripening process by ethrel resulted into more conversion of starch into reducing during ripening than the control. The resembling results were observed by Sing *et al.* (2012a) [11] in papaya, Dhillon and Mahajan (2011) [4] in pear fruits,

Kulkarni *et al.* (2004) [5] in mango fruits cv. Neelum, Nair and Singh (2003) [14] in mango cv. Kensington.

Non-reducing sugar (%)

Similar trends was observed in case of reducing sugar (%) at 2nd, 4th, 6th and 8th day of storage period, different chemicals shows significant effect on the accumulation of non-reducing sugar. The maximum non-reducing sugar (%) was noted in ethrel @ 1250 mg/l (E₄) treatment at 2nd and 4th day of storage (9.89 and 15.56%) which was at par with E₃ treatment at 4th day (14.61%) of storage. While, at 6th and 8th day of storage period significantly the maximum non reducing sugar (17.07 and 15.16%) was found with ethrel @ 1000 mg/l (E₃) which was at par with E₂ at 6th day (16.25%) of storage period. Minimum non-reducing sugar was noted in E₀ (no ethrel) treatment during 2nd, 4th, 6th and 8th day storage (8.23, 12.61, 13.57 and 12.53%, respectively). The increase in the level of non-reducing sugar was possibly due to ripening of fruits which is associated with high metabolic changes in the fruits leading to conversion of complex polysaccharide into simple sugars due to the application of ethrel. Similar result was recorded by Singh *et al.* (2012 a) [11] in papaya and Nair and Singh (2003) [14] in mango cv. Kensington.

Total carotenoids (mg/100 g pulp)

Total carotenoids (mg/100 g pulp) were significantly differs by different concentrations of ethrel. The maximum total carotenoids at 2nd and 4th day of storage period (2.28 and 2.84 mg/100 g pulp) were found when papaya fruits were treated with ethrel 1250 mg/l (E₄) while maximum total carotenoids were found at 6th and 8th day storage period (3.07 and 2.24 mg/100 g pulp). The significantly minimum total carotenoids (1.74 and 2.30 mg/100 g pulp) were observed at 2nd and 4th day of storage with no ethrel treatment (E₀) while at 6th and 8th day of storage total carotenoids were significantly minimum (2.70 and 1.85 mg/100 g pulp). Ethylene might increase the carotenoid through its synthesis. This fact was established by Young and Jahn (1972) [15] in citrus and Sing *et al.* (2012a) [11] in papaya.

Conclusion

It can be concluded from the present investigation that use of ethrel had a significant impact on the papaya fruits because the ethrel treated fruits shows higher T.S.S., sugar, ascorbic acid and total carotenoid while, lower acidity, for a shorter duration than control, Among the treatments ethrel application @ 1000 mg/l was the best for retaining the various biochemical attributes followed by ethrel application @ 750 mg/l up to 8 days of storage

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