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Response of different chemical treatment on shelf-life and quality of tomato fruits (cv. GT-1) during storage in summer season

■ H.J. SENJALIYA*, R.P. RAJPUT[1], S.N. GALANI[1] AND G.S. MANGAROLIYA[1]
Department of Horticulture, Junagadh Agricultural University, JUNAGADH (GUJARAT) INDIA
[1]Agriculture Research Station (Fruit Crops), Junagadh Agricultural University, Mahuva, BHAVNAGAR (GUJARAT) INDIA
Email : hjpatel25@gmail.com

*Author for Correspondence

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SUMMARY :

The present investigation was carried out to study the response of different chemical treatment on shelf-life and quality of tomato fruits. The fruit samples were drawn and analysed periodically for various physical and bio-chemical changes. In summer results revealed that tomato fruits treated with post harvest treatments of $KMnO_4$ + BLE reduce ripening and gave maximum marketable fruits with increased shelf-life of tomato fruits. The minimum loss in weight was noted when tomato fruits treated with 2 per cent bael leaf extract. The fruits treated with $KMnO_4$ 3000 ppm + 2 per cent BLE increased the per cent marketable fruits with increase in storage period. Maximum shelf-life (10 days) was observed in fruits treated with $KMnO_4$ 2000 ppm + 2 per cent BLE and $KMnO_4$ 2000 ppm alone. Maximum acidity was recorded in T_1 with 2 per cent bael leaf extract. Ascorbic acid content was highest with the post harvest application of GA_3 400 ppm in combination with 2 per cent bael leaf extract. The fruits treated with GA_3 increases TSS, reducing sugar and total sugar at initial and later stage of storage, but acidity was increased at later stage of storage. Maximum percentage of reducing and total sugar was recorded in control condition.

KEY WORDS : Tomato, Summer, Storage, Shelf-life, Bale leaf extract, $KMnO_4$, GA_3

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Tomato is a solanaceous fruit and one of the most popular vegetables grown all over the world. Tomato ripening used to be thought of simply as the result of a series of degradative processes, probably because some of the more obvious changes require the action of hydrolytic enzymes. In tomato application of chemical as pre-and post harvest sprays or dips offer great promise in extending the shelf-life of horticultural commodities. Use of GA_3 and kinetin having anti-senescence properties has been found effective in extending the shelf-life of many fruits and vegetables. Application of $KMnO_4$ as ethylene scrubber has been

reported to play an important role in prolonging the shelf-life of mature green and red ripe tomatoes. Application of bael leaf extract helps in reducing the micro-flora. In order to achieve the following objectives, the performances of these chemicals in extending the storage life the tomato fruits were dipped in its solutions.

EXPERIMENTAL METHODS

The present investigation was conducted at the Department of Horticulture, College of Agriculture, Junagadh Agricultural University, Junagadh during summer and *Kharif* season on tomato cv. GT-1. The experiment was laid out in a Completely Randomized Design with two concentration of GA_3 *viz.*, 200 and 400 ppm and three concentration of $KMnO_4$ *viz.*, 1000, 2000 and 3000 ppm and its combination with 2 per cent bael leaf extract (BLE) with three replications. Each treatment was consisted of 2 kilogram fruits and stored in ambient condition. The tomato fruits were free from mechanical damage, bruises, sun burns and fungal/insect attacks and fruits were uniform size and maturity, harvested at turning stage retaining small pedicel intact, having specific gravity between 1.02 and 1.04 were selected in summer season.

Method of treatment :

The treatments were given as post-harvest dips. In these treatments, the fruits were dipped for 10 minutes in gibberellic acid 200 and 400 ppm, bael leaf extract 2 per cent and then air dried for 30 minutes after each treatment. For the treatment of $KMnO_4$. This $KMnO_4$ 1000, 2000 and 3000 ppm solution applied only to the newspaper, which were dipped in the aqueous solution and after complete drying used as a cushioning material in the cardboard boxes employed for packaging of tomato fruits. In post-harvest dips for mixed application, for gibberellic acid and bael leaf extract treatment, fruits were dipped in mix solution of gibberellic acid and bael leaf extract for 10 minutes. For $KMnO_4$ and bael leaf extract treatment, fruit were dipped in solution of bael leaf extract at 10 minutes and then fruits were wrapped in newspapers and placed in cardboard boxes.

Statistical analysis:

The obtained data was analyzed by statistical significant at $P<0.05$ level, S.E. and C.D. at 5 per cent level by the procedure given by (Gomez and Gomez, 1984).

EXPERIMENTAL FINDINGS AND ANALYSIS

The results obtained from the present investigation as well as relevant discussion have been summarized under following heads :

Physiological loss in weight :

On the 4th day of storage the minimum weight loss (1.32%) was observed in treatment T_9 and at 12th day of storage the minimum per cent weight loss 6.24 per cent was observed in treatment T_1, respectively. Reduced weight loss with bael leaf extract treatments has been reported by Kumar *et al.* (2005) and Kumar *et al.* (2005).

Marketable fruits (%) :

The maximum marketable fruits (60.00 %) on 4th day of storage were observed in treatment T_{12} and at 12th day of storage maximum marketable fruit per cent (63.89 %) was found in treatment T_{11}, respectively. In the initial stage fruits were hard, green and unmarketable but at later stages of storage treatment T_{11} was found best for ripening and it gave firm, bright red colour with good flavour fruits, as the concentrations of the treatment increased the colour and quality of fruits were deteriorated, as higher levels failed to ripen and restricted breakdown of chlorophyll and conversion of starch to sugar. The results were confirmed with Kumar *et al.* (2005).

Shelf-life (days) :

The data indicated that the shelf-life of tomato fruits was significantly influenced by various post-harvest treatments during storage. The maximum shelf-life (10.00 days) was found in treatments T_{10} and T_7. It was due to the compounds of $KMnO_4$ + BLE that minimize the degradation of chlorophyll, ascorbic acid, less carotenoid accumulation, rate of respiration, protein breakdown and decrease in enzyme activities. The findings were by Stead and Chithambo (1980); Kumar *et al.* (2005); Sharma and Dashora (1999); Sandooja *et al.* (1987) and Kumar *et al*. (1988) in tomatoes and Varit and Songsin (2011) in banana.

Spoilage fruit (%) :

The data indicated that lowest spoilage of fruit (0.0 %) was noted in treatment T_5, T_9 and T_{11} on 4th day of storage and at 12th day of storage minimum spoilage of fruit (30.00 %) was noted in treatment T_{10}, respectively.

Table 1 : Effect of post harvest treatments on physiological loss in weight, marketable fruits, shelf-life, spoilage and firmness of tomato fruit during storage in summer season

Tr. No.	Treatments	Physiological loss in weight (%)		Marketable fruits (%)		Shelf-life in days	Spoilage (%)		Firmness (kg/cm^2)	
		Storage period (days)					Storage period (days)			
		4	12	4	12		4	12	0	12
T_1	2% Bael leaf extract	1.38	6.24	45.68	55.29	9	11.25	38.45	0.34	0.20
T_2	GA_3 200 ppm	1.79	7.14	44.68	51.64	8	15.86	48.64	0.35	0.20
T_3	GA_3 400 ppm	1.93	7.15	56.74	50.43	9	17.53	47.35	0.37	0.19
T_4	GA_3 200 ppm + 2% BLE	1.82	7.10	58.96	52.36	7	16.23	42.72	0.36	0.17
T_5	GA_3 400 ppm + 2% BLE	1.34	6.50	51.26	53.48	8	0.00	38.33	0.36	0.19
T_6	$KMnO_4$ 1000 ppm	1.39	7.25	49.85	55.84	9	8.20	32.69	0.34	0.20
T_7	$KMnO_4$ 2000 ppm	1.85	7.16	55.24	56.28	10	7.20	36.46	0.33	0.21
T_8	$KMnO_4$ 3000 ppm	1.87	7.09	52.54	52.68	8	12.67	35.28	0.36	0.18
T_9	$KMnO_4$ 1000 ppm + 2% BLE	1.32	7.21	51.28	59.68	9	0.00	33.59	0.35	0.19
T_{10}	$KMnO_4$ 2000 ppm + 2% BLE	1.37	7.29	47.67	60.48	10	4.20	30.00	0.34	0.22
T_{11}	$KMnO_4$ 3000 ppm + 2% BLE	1.61	7.18	48.36	63.89	9	0.00	35.94	0.35	0.20
T_{12}	Control	1.59	9.10	60.00	40.21	5	20.14	58.21	0.36	0.16
	S.E. ±	0.02	0.09	0.67	0.75	0.17	0.13	0.55	0.01	0.00
	C.D. (P=0.05)	0.06	0.27	1.95	2.19	0.49	0.36	1.61	0.01	0.01
	C.V. (%)	2.16	2.19	2.23	2.39	3.43	2.29	2.41	2.47	2.11

BLE = Bael leaf extract

Table 2: Effect of post harvest treatments on total soluble solids, reducing sugar, total sugar, acidity and ascorbic acid of tomato fruit during storage in summer season

Tr. No.	Treatments	Total soluble solids (%)		Reducing sugar (%)		Total sugar (%)		Acidity (%)		Ascorbic acid mg/100 g	
		Storage period (days)									
		0	12	0	12	0	12	0	12	0	12
T_1	Bael leaf extract 2% (BLE)	4.24	5.35	0.26	1.70	0.61	4.98	0.76	0.65	29.81	37.45
T_2	GA_3 200 ppm	4.27	5.47	0.25	1.72	0.63	4.99	0.77	0.63	29.79	36.96
T_3	GA_3 400 ppm	4.26	5.42	0.24	1.74	0.64	5.00	0.78	0.64	29.76	36.97
T_4	GA_3 200 ppm + 2% BLE	4.24	5.33	0.26	1.68	0.63	5.01	0.75	0.65	29.78	36.72
T_5	GA_3 400 ppm + 2% BLE	4.25	5.28	0.25	1.70	0.65	4.94	0.78	0.64	29.75	37.50
T_6	$KMnO_4$ 1000 ppm	4.25	5.32	0.27	1.56	0.62	4.92	0.77	0.64	29.77	36.91
T_7	$KMnO_4$ 2000 ppm	4.27	5.40	0.26	1.67	0.61	4.91	0.76	0.63	29.76	37.15
T_8	$KMnO_4$ 3000 ppm	4.26	5.45	0.24	1.68	0.64	4.89	0.75	0.62	29.80	37.20
T_9	$KMnO_4$ 1000 ppm + 2% BLE	4.25	5.49	0.25	1.65	0.63	4.85	0.76	0.61	29.78	36.97
T_{10}	$KMnO_4$ 2000 ppm + 2% BLE	4.24	5.43	0.26	1.65	0.62	4.84	0.77	0.63	29.77	37.22
T_{11}	$KMnO_4$ 3000 ppm + 2% BLE	4.27	5.47	0.24	1.61	0.65	4.83	0.77	0.61	29.79	37.21
T_{12}	Control	4.26	5.43	0.27	1.81	0.66	5.13	0.76	0.59	29.76	36.25
	S.E. ±	0.05	0.04	0.00	0.03	0.01	0.05	0.01	0.01	0.10	0.21
	C.D. (P=0.05)	NS	0.13	0.01	0.08	0.03	0.16	0.02	0.03	NS	0.60
	C.V. (%)	1.92	1.39	2.54	2.70	2.37	1.93	1.51	2.76	0.56	0.96

BLE= Bael leaf extract; NS = Non-significant

The antisenescent properties of $KMnO_4$ + bael leaf extract help in maintaining the fruits on fresh condition during storage, that findings of Kumar *et al.* (2005).

Firmness of fruit (kg/cm^2) :

The highest firmness (0.30 kg/cm^2) was found in treatment T_9 at 4th day of storage and at 12th day of storage the highest firmness (0.22 kg/cm^2) was found in treatment T_{10}, respectively. The similar results were confirmed with Sashikala *et al.* (2002); Kumar *et al.* (2005) in tomato and Seymour (1993) and Siribon and Banlusilp (2004) in banana.

Total soluble solids (TSS) (%) :

The data indicated that the TSS of fruits was significantly influenced by various post harvest treatments during storage. The highest TSS (5.49%) was observed in treatment T_9 on 12th day of storage. Due to accumulation of sugar as consequence of starch hydrolysis, while the later it decreased due to consumption of sugar for respiration during storage. Similar trend was recorded by Kumar *et al*. (2005); Sandooja *et al.* (1987) and Kumar *et al*. (1988) in their findings in tomato.

Reducing sugar (%) :

The highest reducing sugar content of 1.81 per cent was observed in treatment T_{12} on 12th day of storage. It is corroborated to the fact that the treatments stimulated the rate of starch hydrolysis and increased rate of respiration and oxidation might be responsible for retention of sugars during storage. Similar trend was obtained by Viradia (1982).

Total sugar (%) :

There was significant difference found in various treatments on 12th day of storage. The highest total sugar content of 5.13 per cent was observed in T_{12} on 12th day of storage. It can also be observed that total sugar content was reduced in the later period of storage. This may be due to their rapid utilization in respiration. These are in confirmation with those obtained by Vyas (2004) and Wills *et al.* (1989) in banana.

Acidity (%) :

It is apparent from the data that acidity of tomato fruits in various treatments exhibited significant difference during storage and there was constant decrease in acidity during the entire period of storage. On 12th day of storage highest acidity (0.65%) was observed in treatment T_1 and T_4. Due to their effects on the utilization of organic acids in respiration which delays ripening and restricts starch degradation hence, results in higher acidity contents. This result was confirmed with the findings of Yeneko and Loo (1980).

Ascorbic acid (mg/100g pulp) :

The data indicated that the ascorbic acid content in various treatments exhibited significant difference during days of storage. On 12th day of storage highest ascorbic acid (37.50 mg /100 g) was noted in treatment T_{10}. This result was confirmed with the findings of Kumar *et al*. (2005).

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