Science Vision volume 15 number 4

Original Research

2015
October-December
ISSN (print) 0975-6175
ISSN (online) 2229-6026

Effect of different concentrations of maleic hydrazide on the post-harvest life of tomato fruits

Chhungpuii Khawlhring and Laishram Maiken Singh

Department of Horticulture, Aromatic & medicinal Plants, Mizoram University, Tanhril, Aizawl 796004, India

Received 12 October 2015 | Revised 16 December 2015 | Accepted 20 December 2015

Abstract

Green mature fruits of tomato were harvested in the morning and subjected to treatments on the same day by dipping in maleic hydrazide of different concentrations such as control (T_0), 100 ppm (T_1), 200 ppm (T_2), 300 ppm (T_3) and 400 ppm (T_4) respectively. The fruits were stored in ambient condition for one month, and physical observations such as fruit weight, colour and fruit firmness were taken at 3-day interval, whereas chemical observations such as total soluble solids (TSS), titratable acidity, reducing sugar and non-reducing sugar contents were analysed at 5 days interval and lycopene contents estimated at the end of the experiment. Loss of fruit weight, colour change and reduced firmness was observed in all the fruits, but the fruits with 400ppm maleic hydrazide treatment showed best retention of colour as well as fruit firmness up to the end of the experiment.

Key words: Maleic hydrazide; post-harvest quality; tomato; fruit.

Introduction

Tomato (*Lycopersicon esculentum*) belongs to the genus Lycopersicon under Solanaceae family. They are harvested at different maturity stages, such as green mature stage, half ripe stage and red ripe stage depending upon their intended use. Tomatoes have a very short life span, and thus increase in the storage life and also retention of fruit quality during storage is necessary for the fruits.

Corresponding author: Khawlhring
Phone: +91-9436376361
E-mail: puii.kh@gmail.com

A number of chemical and physical processes take place in tomatoes during storage. The shelf life is a period of time which starts from harvesting and extends up to the start of rotting of fruits.[1] Maturity stage at harvest is one determinant factor for different post-harvest quality attributes of tomato, that ultimately affect fruit qualities such as soluble solid, sugar, acidity, pH, colour and firmness both in fresh market and processed tomatoes. Further, use of various chemicals may have profound effect on the quality retention of tomato fruits during storage. Maleic hydrazide (MH, 1,2-dihydro-3,6-pyridazinedione; coline salt) is a growth regulator that is widely used in agriculture such as an

inhibitor of sucker development in tobacco, and as a retardant of shoot growth in grape.[2] The present experiment is carried out to determine the effects of maleic hydrazide at different concentrations on the post-harvest storage quality of tomato fruits.

Materials and Methods

Plant materials and treatments

The experiment was conducted during February and March, 2015. Green mature tomato fruits were harvested in the morning from a local farm, and subjected for treatments in the laboratory of the department of HAMP, Mizoram University, Tanhril, Aizawl. Five (5) different treatments were given to the fruits by dipping in solution of maleic hydrazide at different concentrations. They are

T_0 = Control
T_1 = 100 ppm maleic hydrazide
T_2 = 200 ppm maleic hydrazide
T_3 = 300 ppm maleic hydrazide
T_4 = 400 ppm maleic hydrazide

At each treatments there are three (3) replications consisting of six (6) fruits each. The fruits were kept in ambient condition and physical as well as chemical observations were taken until senescence.

Physical observations

The weight, colour and firmness of the tomato fruits were taken and the records maintained at 3- day interval. Fruit weights were determined by using a digital weighing balance and recorded every day during the experiment. The colour of tomato fruits were observed visually, and for ease of identification, the colours were determined with 7 different scores as follows

Dark green	1
Light green	2
Slight colour break	3
Half Red	4
3/4th Red	5
Full Red	6
Deep Red	7

Fruit firmness were checked by light pressing of fruits with hands, and given a firmness score as follows,

Firm	:	F	(1)
Moderately firm	:	MF	(2)
Less firm	:	LF	(3)

Chemical Analysis

Chemical contents of tomato fruits such as TSS, titratable acidity, reducing sugar and non-reducing sugar were estimated at an interval of 5 days, and lycopene content was estimated at the end of the experiment. The total soluble solids (TSS) content of tomato fruits were measured by using a hand refractometer and expressed in ° Brix. Titratable acidity, reducing sugar and total sugar contents of the tomato fruits were determined by following the methods laid by Srivastava and Kumar.[3] Lycopene content of tomato fruits were estimated after extracting the pigments in acetone, and transferring into petroleum ether phase, as also described by Srivastava and Kumar.

Statistical analysis

The data obtained were analysed by completely randomized design. Significance and non -significance of the variance due to different treatments were determined by calculating the respective 'F' value and comparing with the appropriate value of 'F' at 5 per cent probability level.[4]

Results and Discussions

Tomato fruits with treatments of different concentrations of maleic hydrazide were subjected to analysis of various postharvest physico-chemical quality characteristics during the observation. Important quality characteristics of tomato such as; weight, colour, firmness, TSS,

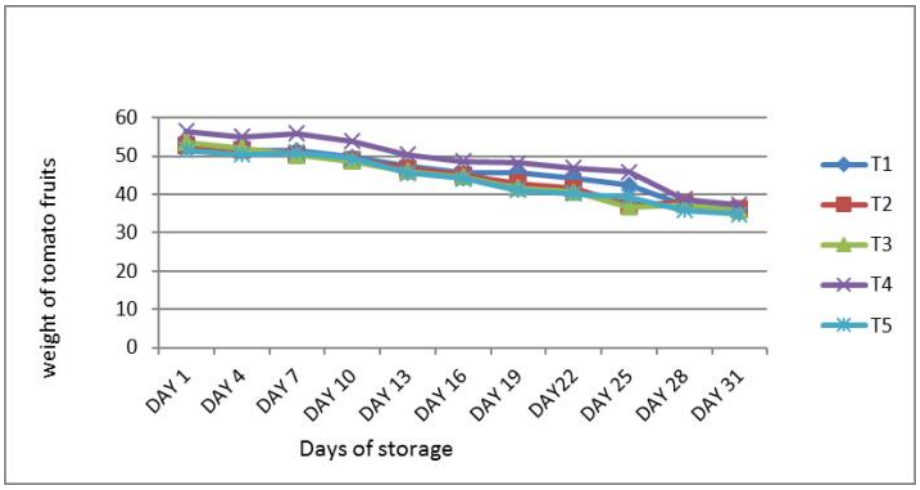

Figure 1. Changes in weight of tomato fruits with different concentration of maleic hydrazide.

acidity, sugar content and lycopene content were determined. Fruit ripening and senescence are accompanied by changes in several quality aspects such as softening, decrease in total acidity and increase in sugar contents, color development, aroma production etc.[5]

Physical analysis

Weight

A decreasing pattern in the weight of fruits with storage period is observed with all the treatments. However, there is no significant differences in fruit weight with different doses of maleic hydrazide.

Colour

As presented in Table 1, the tomato fruits show change in colour from green to red during different days of observation. In the first four days of observation, colour change was observed but was not significant with different treatments, whereas beyond this day, the colour change was significant with different treatments. It is observed that different treatments of tomato fruits showed increase in colour score during storage, then after reaching their maximum score, the score gradually decrease. Control (T_0) and T_1 showed increase in colour score up to 25 DAS (days after storage), then decreases. T_2 and T_4 recorded increased colour score up to 16 DAS, then decreases, whereas T_3 showed increased colour score up to 19 DAS, then after 22 DAS, it decreased.

Fruit firmness

The effect of post-harvest application of different concentration of maleic hydrazide on firmness of tomato fruit is shown in table 2. There was loss in fruit firmness in T_0, T_1, T_2 and T_3 treatments during the entire experiment period, whereas T_4 recorded a slight decrease in firmness at 4 DAS, but again increased from 7 DAS onwards and remain sufficiently firm throughout the experiment.

Chemical analysis

Total soluble solids (TSS)

There was slight increase in TSS content of tomato fruits during storage in all the maleic hydrazide treated fruits and control (Table 3). However, no significant change with different treatments were observed.

Titratable acidity

The titratable acidity content of tomato fruits decreased in storage with all the treatments (Table 4). The change in acidity content does

Table 1. Effect of post-harvest treatment with different concentrations maleic hydrazide on fruit colour of tomato during storage.

Treatment	Day 1	Day 4	Day 7	Day 10	Day 13	Day 16	Day 19	Day 22	Day 25	Day 28	Day 31
T_0	2.47	3.80	4.07	4.60	5.17	5.67	6.00	6.00	6.50*	6.33	6.33
T_1	2.97	3.83	4.00	4.60	4.97	5.40	5.43	5.50	5.50*	5.33	5.33
T_2	2.30	3.37	3.47	4.07	4.13	4.73*	4.47	4.47	4.33	4.33	4.33
T_3	2.70	3.83	3.73	4.67	5.03	5.13	5.27	5.27*	4.83	4.67	4.67
T_4	2.63	3.20	3.00	3.33	3.30	3.53*	3.37	3.43	2.67	2.67	2.67
Cd (0.05)	NS	NS	0.76	0.89	0.92	0.96	0.87	0.88	1.26	1.65	1.65
SEd	-	-	0.37	0.43	0.44	0.46	0.42	0.42	0.61	0.79	0.79

*Score on a scale of 1-7.

Table 2. Loss of fruit firmness as affected by post-harvest treatment with different concentrations of maleic hydrazide on tomato fruits during storage.

Treatment	Day 1	Day 4	Day 7	Day 10	Day 13	Day 16	Day 19	Day 22	Day 25	Day 28	Day 31
T_0	1.10	1.33	1.53	1.67	1.47	1.67	1.80	2.10	2.33	2.00	2.33
T_1	1.13	1.30	1.33	1.53	1.33	1.47	1.63	1.97	2.00	2.00	2.00
T_2	1.10	1.30	1.33	1.40	1.30	1.40	1.40	1.53	1.50	1.67	2.00
T_3	1.17	1.37	1.43	1.60	1.63	1.63	1.70	1.97	1.83	2.33	2.33
T_4	1.17	1.37	1.20	1.20	1.07	1.20	1.00	1.10	1.33	1.00	1.00
Cd (0.05)	NS	NS	NS	0.29	0.34	0.33	0.54	0.57	NS	0.62	0.62
SEd	-	-	-	0.14	0.16	0.16	0.26	0.27	-	0.30	0.30

Table 3. Effect of post-harvest treatment with different concentrations of maleic hydrazide on TSS (oBrix) of tomato.

Treatments	Total soluble solids (°Brix)					
	5 DAS	10 DAS	15 DAS	20 DAS	25 DAS	30 DAS
T_0	4.90	5.00	5.07	5.10	5.10	5.17
T_1	4.93	4.90	5.03	5.00	5.00	5.03
T_2	4.97	5.00	4.97	5.03	5.03	5.07
T_3	4.97	5.00	5.00	5.00	5.00	4.97
T_4	4.93	4.97	4.93	4.93	4.97	5.00
Cd (0.05)	NS	NS	NS	NS	NS	NS
SEd	-	-	-	-	-	-

Table 4. Effect of post-harvest treatment with different concentrations of maleic hydrazide on titratable acidity (%) of tomato.

Treatments	5 DAS	10 DAS	15 DAS	20 DAS	25 DAS	30 DAS
T_0	1.28	0.70	0.61	0.49	0.36	0.27
T_1	0.87	1.08	0.81	0.70	0.61	0.34
T_2	0.89	0.72	0.70	0.61	0.49	0.34
T_3	0.72	0.68	0.83	0.68	0.62	0.51
T_4	1.10	0.79	0.72	0.63	0.46	0.34
Cd (0.05)	0.29	NS	NS	NS	0.15	0.14
SEd	0.14	-	-	-	0.07	0.07

Table 5. Effect of post-harvest treatment with different concentrations of maleic hydrazide on reducing sugar content of tomato fruits.

Treatments	5 DAS	10 DAS	15 DAS	20 DAS	25 DAS	30 DAS
T_0	2.60	2.89	4.18	4.95	3.45	3.06
T_1	3.03	3.49	4.07	4.49	4.10	3.13
T_2	2.79	3.05	4.37	4.80	4.13	4.12
T_3	2.47	3.70	4.37	4.83	3.97	3.80
T_4	2.59	3.19	4.10	4.60	3.80	3.15
Cd (0.05)	NS	NS	NS	NS	NS	0.80
SEd	-	-	-	-	-	0.38

Table 6. Effect of post-harvest treatment with different concentrations of maleic hydrazide on total sugar content of tomato fruits.

Treatments	5 DAS	10 DAS	15 DAS	20 DAS	25 DAS	30 DAS
T_0	3.66	4.32	5.57	7.13	5.49	4.16
T_1	4.30	4.96	6.35	6.32	5.35	4.61
T_2	4.44	4.30	5.82	7.16	6.35	5.71
T_3	3.89	5.92	5.98	6.74	5.85	4.67
T_4	3.66	4.65	6.22	7.10	6.16	5.10
Cd (0.05)	NS	NS	NS	NS	NS	NS
SEd	-	-	-	-	-	-

not show significant differences with different treatments up to 20 days after storage (DAS), however, at 25 DAS there was significant difference in T_1 and T_3, and at 30 DAS significant difference was again observed at T_3 as compared to control. Wills *et al.*[5] also mentioned that the amount of organic acids usually decreases during maturity, as organic acids are substrates of respiration.

Reducing sugar

The reducing sugar contents of tomato fruits increased during storage up to 20 DAS, then decreased in all the treatments (Table 5). The difference with different treatments were not significant up to 25 DAS, and at 30 DAS the treatment T2 showed significant difference compared to control. The increase in reducing sugar with the progress of ripening as well as storage time was due to the degradation of starches to glucose and fructose by the activities of amylase and maltase.[5]The increase in reducing sugar could also be attributed to enzymatic conversion of starch to reducing sugar.

Total sugar

The total sugar content of tomato fruits also increased upto 20 DAS, then decreased in most of the treatments, with an exception of T_1 that showed highest total sugar content at 15 DAS that decreased gradually (Table 6).

In general, produce with a higher rate of respiration ripens faster and has a shorter shelf life than produce with a lower respiration rate. The metabolic activity of the tissue can be monitored through the respiration rate.[5] Accordingly, the rate of change in total sugar could be an indication of rate of respiration in the fruit. Further, the respiration rate gives an indication of the rate of breakdown of respiratory substrates such as starch, sugars and organic acids.[6]

Lycopene content

Lycopene contents were estimated at the end

of the experiment, i.e. 30 DAS, and the differences compared as shown in Table 7. Here, the fruits of control showed highest lycopene content, whereas the maleic hydrazide treated fruits showed comparatively lesser contents of lycopene with increasing level of Maleic Hydrazide concentration, and the highest concentration among the treatments, i.e., T_4 showed apparently very less lycopene content.

From the physical observation, loss of physical weight of the fruits were observed in all the treatments and control. Colour change and loss of fruit firmness was also observed in most of the treatments and control, however, T_4 (400 ppm maleic hydrazide) showed apparently very less colour change, as well as the fruits remain sufficiently firm even after 30 days of storage.

Table 7. Effect of post-harvest treatment with different concentrations of maleic hydrazide on lycopene content of tomato fruits.

Treatment	Lycopene
T0	29.44
T1	18.36
T2	12.03
T3	4.85
T4	0.66
Cd (0.05)	NS
SEd	-

From the chemical analysis, it is observed that the TSS contents slightly increased, titratable acidity decreased, the reducing and non-reducing sugar contents increased up to 20 DAS, then decreased with storage time. And there was marked difference in the lycopene content of tomato fruits with different treatments, after 30 days of storage, and the fruits with 400 ppm of maleic hydrazide (T_4) contains the least lycopene content which signifies least colour change with storage. This agrees with our colour score in the physical observation, where apparently very less colour change was observed up to 30 days of storage of the tomato fruits.

Conclusions

With increase in storage time, increase in TSS, reducing sugar and total sugars, as well as decrease in titratable acidity were observed in tomato fruits, while marked differences in the lycopene contents of the tomato fruits were observed when treated with different concentrations of maleic hydrazide. Tomato fruits treated with 400 ppm of maleic hydrazide showed best retention of colour and fruit firmness as compared to all other treatments as well as untreated fruits in the present experiment.

Acknowledgement

The authors are thankful to Dr T.K. Hazarika, Assistant Professor, Departmentof HAMP, MZU for helping them out with the necessary analysis of data.

References

1. Mondal MF (2000). *Production and Storage of Fruits* (in Bangla). Mrs.Afia Mondal.BAU Campus, Mymen Singh-2202, p. 312.
2. Kamuro Y (1995). Review of PGRs and their development in the future. *Chem Reg Plants,* **30**, 197–216.
3. Srivastava and Kumar (2002). *Fruits and Vegetable Preservation: Principles and Practices*.
4. Panse VG and Sukhatme PV (1985). *Statistical Methods for Agricultural Workers*. ICAR, New Delhi.
5. Wills R, Glasson M, Graham D, Joyce D (1998). *Post Harvest. An Introduction to the Physiology and Handling of Fruit, Veg. Ornamentals*. 4th ed. UNSW Press, p. 213.
6. Knee M (1995). Do tomatoes on the plant behave as climacteric fruits? *Physiol Plant*, **95**, 211–216.