Vol 2 No 3 September 2021 Pages 13-20 e-ISSN 2708-5694

Journal of Agriculture, Food and Environment (JAFE)

Journal Homepage: http://journal.safebd.org/index.php/jafe

http://doi.org/10.47440/JAFE.2021.2303

Original Article

Effects of varieties and organic postharvest treatments on shelf life and quality of cherry tomato

A. Estiaque, M. H. A. Rashid* and M. G. Rabbani

Department of Horticulture, Bangladesh Agricultural University, Mymensingh, 2202, Bangladesh

Article History

Received: 10 July 2021

Revised: 7 September 2021

Accepted: 8 September 2021

Published online: 30 September 2021

***Corresponding Author**

M. H. A. Rashid, E-mail: harun_hort@bau.edu.bd

Keywords

Cherry tomato, Binatomato 10, BARI Tomato 11, shelf life, quality

ABSTRACT

The present experiment was carried out at the Laboratory of the Department of Horticulture, Bangladesh Agricultural University, Mymensingh during the period from February to April 2020 to study the effects of varieties and organic postharvest treatments on shelf life and quality of cherry tomato. The two-factor experiment consisted of two varieties viz. Binatomato 10 and BARI Tomato 11, and five organic postharvest treatments viz. control, chitosan coating (0.2%), garlic extract (1:1), hot water (50 °C for 5 mins) + chitosan coating (0.2%) and hot water (50°C for 5 mins) + garlic extract (1:1). The experiment was carried out in a completely randomized design with 3 replications. The maximum weight loss (8.93%) was recorded in BARI Tomato 11 treated with garlic extract, while the minimum (5.93%) was found in Binatomato 10 treated with hot water + chitosan coating. The maximum TSS (8.67%) was recorded from BARI tomato 11 treated with control and the minimum TSS (6.13%) was found in Binatomato 10 treated with hot water + chitosan coating. The highest disease incidence (12.67%) and severity (21.67%), and shortest shelf life were recorded in BARI Tomato 11 fruits treated with control, whereas the lowest disease incidence (3.67%) and severity (3.57%), and longest shelf life (31.00 days) were found in Binatomato 10 fruits treated with hot water + chitosan coating. Therefore, Binatomato 10 treated with hot water + chitosan coating was found to be better in respect of extension of shelf life and quality retention of cherry tomato.

Introduction

Cherry tomato (*Solanum lycopersicum* L. *var. cerasiforme*) belonging to the family Solanaceae, is a popular table tomato, which is smaller in size (1.5-3.5 cm in diameter), spherical to slightly oblong in shape and usually red in color which believed to be an intermediate genetic admixture between wild current-type tomatoes and domesticated garden tomatoes (Nesbitt and Tanksley, 2002). Now a day's cherry tomato is becoming more and more demanding in the market because of its high quality and good taste (Kobryn and Hallmann, 2005). Cherry tomatoes are smaller in size (1.5-3.5 cm in diameter), spherical to slightly oblong in shape, and usually red in color. It has great health benefits due to its high content of antioxidant and anti-carcinogenic property, vitamin A and vitamin C, ascorbic acid, and phytochemical compounds, including lycopene, beta-carotene, flavonoids and many essential nutrients (Rosales *et al*., 2011). The fruits can be used directly as raw vegetable, salad and after cooking. Cherry tomato is a new crop for Bangladesh, and many consumers unfamiliar with the small-fruited tomatoes and hence, production and postharvest management of cherry tomato could be a profitable activity for the Bangladeshi farmers. Fresh vegetables are very important for vitamins and minerals daily requirement of vegetables is 400 g/day/capita (FAO, 2003) but the present consumption of vegetables in Bangladesh is only 211 g/day/capita.

Postharvest losses are very high in fruit, vegetables and root crops as they are less hardy and perishable in nature, and due to improper harvesting, poor handling and transport, they soon decay and become unfit for human consumption. In Bangladesh, vegetables were wasted about 23.6-43.5% (Hassan, 2010). The present vegetable production in Bangladesh is around one million tons for every year, 70% of which is delivered during the cool season. Accordingly, there is an intense lack of vegetables during the late spring, which leads to chronic malnutrition vegetables produced in these areas are transported to the capital or other cities as soon as possible through different marketing channels (Hossain, 2000). To meet the requirement of vast number of people's demand of vegetables it is needed to reduce postharvest loss.

Cherry tomatoes rapidly deteriorate after ripening, and a large portion of the valuable products are lost after harvest. In tropical countries, a loss of 20-50% has been reported for fresh tomatoes during harvest, transport and consumption process (Pila et al. 2010). Major causes of losses are high perishability, microbial contamination, loss of water content, pathogen attack during storage and careless handling operations. The perishability of the fruits is associated with the increases in physiological and physico-chemical changes, such as loss of weight, respiration, transpiration, softening of pulp, sugar, and acid contents (Firmin, 1997). Current postharvest problems are mainly concerned with shelf life. The postharvest losses of fruits and vegetables can be reduced by prolongation of shelf life, which can improve the present situation (Rashid *et al*., 2019). Heat treatments at different temperatures with appropriate time can be successfully applied for the disinfestations of disease and insect pests in fresh fruit (Rashid *et al*., 2015). Though life span of cherry tomato is short we can use different postharvest treatments to extent shelf life.

Research showed that chitosan coatings extend the shelf life of the fruits and vegetables by minimizing the rate of respiration and reducing the water loss. Chitosan coating works against bacterial contamination and loss of moisture from the surface of food products, thus extending their shelf life (Sheikh *et al*., 2013). Chitosan-coated tomatoes were firmer, higher in titratable acidity, and exhibited less biochemical changes than the control fruit at the end of storage (Kabir and Sabir, 2018). Lanza *et al.* (2000) reported that hot water dip at 52°C for 180s was effective in controlling postharvest decay of lemon.

Different studies explained that different postharvest treatments reduced postharvest decay, controlled development of physiological disorders, fungal attack, improved quality and delayed senescence or ripening. It develops the skin strength making the cell wall and tissues more resistant and less accessible to the enzymes that are produced by fungi and bacteria, limiting infection. Improper postharvest management is the primary cause of many postharvest loses (Rashid *et al*., 2015). Thus, it is necessary to determine the proper treatments for maximum shelf life of a certain cherry tomato variety. However, very limited postharvest research has been conducted on cherry tomato to extend its shelf life and quality during storage. The present experiment was, therefore, undertaken to study the effects of varieties and organic postharvest treatments on shelf life and quality of cherry tomato.

Materials and methods

Experimental location and material

The present experiment was conducted to study the effect of varieties and organic postharvest treatments on shelf life and quality of cherry tomato at the Laboratory of the Department of Horticulture, Bangladesh Agricultural University, Mymensingh during the period from February to April 2020. Well developed, uniform sized, and healthy cherry tomato fruits were harvested from the Horticulture Farm of the Department of Horticulture, Bangladesh Agricultural University, Mymensingh and taken to the Postgraduate Laboratory and were kept under room temperature prior to further treatments.

Treatments of the investigation and experimental design

The two-factor experiment consisted of two varieties of cherry tomato viz. i) Binatomato 10, ii) BARI Tomato 11, and five postharvest treatments viz. i. Control (T_0), ii. Chitosan coating (0.2%) (T_1), iii. Garlic extracts (1:1) (T_2), iv. Hot water (50 °C for 5 mins) + Chitosan coating (0.2%) (T_3), and v) Hot water (50°C for 5 mins.) + Garlic extracts (1:1) (T_4). The experiment was conducted in a completely randomized design with 3 replications. Twenty cherry tomato fruits were taken under each treatment from which 8 fruits were used as destructive sample and 12 were kept for colour changes, weight loss, disease incidence and severity and shelf life study. Therefore, total number of 600 fruits was used for this experiment for 10 treatment combinations for 3 replications.

Application of postharvest treatments

The postharvest treatments used in the storage were sequentially assigned to the collected fruits. After applying the postharvest treatments on the varieties of cherry tomato fruits were kept on a brown paper which was previously laid out in completely randomized design and placed on the laboratory table at normal temperature. To ensure the application of different storage treatments to the cherry tomato fruits the following procedures were adopted.

Control (T_0)

Fruits were selected randomly from a lot of cherry tomato and the fruits were kept on brown and white paper of the laboratory table at room condition arranging at random by replication.

Chitosan coating (0.2%) (T_1)

Chitosan was used for this treatment. For chitosan coating (T_1) the selected strawberry fruits were dipped at 0.2% chitosan solution for 2 minutes and air-dried. Chitosan solution (0.2%) was prepared by dissolving 0.2 g of chitosan in 90 mL of distilled water added with 2 mL of glacial acetic acid. The mixture was heated with continuous stirring for proper dissolution of chitosan. The final pH of the solution was adjusted to 5.6 with 2 N NaOH and made up to 100 mL with distilled water. An individual fruit was dipped into chitosan suspension, 12 fruits were kept into it and then placed on white paper for observation.

Garlic extracts (1:1) (T_2)

Garlic extracts solution was used for this treatment. For garlic treatment (T_2), initially stock garlic extracts (1 kg garlic cloves and 1 L water) was prepared by crushing the fresh cloves in distilled water using a blender through straining and then cheesed. The stock extract was then used to prepare treatment of 1:1 concentration. An individual fruit was dipped into garlic extracts solution, 12 fruits were kept into it and then placed on white paper for observation.

Hot water (50 °C for 5 mins.) + Chitosan coating (0.2%) (T_3)

12 fruits kept into hot water at 50 °C for 5 minutes. Further an individual fruit was dipped into chitosan suspension, 12 fruits were kept into it and then placed on white paper for observation.

Hot water (50°C for 5 mins.) + Garlic extracts (1:1) (T_4)
12 fruits kept into hot water at 50 °C for 5 minutes. Further an individual fruit was dipped into Garlic extracts solution, 12 fruits were kept into it and then placed on white paper for observation.

Parameters studied
External color
During the entire storage period, the cherry tomato fruits, used for the experiment, were keenly observed everyday but data was recorded on total weight loss as well as physic-chemical changes during 3, 6, 9, 12 and 15 DAS and shelf life 25 days up to damage stage as influenced by different treatments. Changes in external color of cherry tomato fruits were recorded through scoring using a color chart and grouped into following categories:
1 = Green, 2 = Lightly green, 3 = Yellow, 4 = Lightly yellow, 5 =Red, 6 = Lightly red, 7 = Red ripe, 8 = Dark red

Weight loss
For determining the weight loss, fruits were weighed before imposing the treatment, which served as the initial fruit weight. The loss in weight was recorded at 3 days interval until 18 days, which served as the final weight. The physiological loss in weight was determined by the following formula and expressed as percentage.

$$\text{Weight loss (\%)} = \frac{\text{Initial fruit weight - Fruit weight on the day of}}{\text{Initial fruit weight}} \times 100 \text{ Initial fruit weight}$$

Firmness (Kg/cm$_2$)
Firmness was determined by using fruit Penetrometer (Model Cat.No.166), the fruits were punctured at two places opposite to each other in radial axis with the plunger and the pressure required was recorded and expressed in kg/cm^2.

Pulp pH
Fresh tomato fruits were cut into small pieces and macerated with blender and was filtered through muslin cloth. The filtrate was used for measuring the pH using a Portable pH Meter (Model pHS-1701, Shanghai, China), which was standardized with the help of a buffer solution as described by Ranganna (1994).

Total soluble solids (% brix)
Total soluble solids (TSS) content of cherry tomato was estimated 'by using Abbe's Refractometer. A drop of cherry tomato juice squeezed from the fruit on the prism of the Refractometer. Percent TSS was obtained from direct reading of the instrument. Temperature corrections were made by using the methods described by Ranganna (1994).

Percent disease incidence
The cherry tomato fruits were critically examined every day for the appearance of rot. The incidence of fruit rot was recorded every 3rd day. The first count was made at the 6th day of storage. The disease development was identified by the visual quality, which was observed on the scale of 1 to 5 (1 = very bad, 2 = bad, 3 = good, marketable, 4 = very good, and 5 = excellent) (Islam *et al*., 2017). The fruit rot of cherry tomato was identified by the visual comparison with those of the symptoms already published. The incidence of fruit rot was calculated as follows:

$$\text{\% Disease incidence} = \frac{\text{Number of infected fruits}}{\text{Total number of fruits under study}} \times 100$$

Assessment of percent disease severity
The percentage cherry tomato fruits skin disease was recorded five times starting at the 6th day of storage. All the infected fruits were selected to determine percent fruit area infected. The percentage fruit area diseased was measured based on eye estimation.

Dry matter content
The dry matter or dry weight is a measurement of the mass of something when completely dried. The dry matter of tomato consists of all its constituents excluding water.

Shelf life
The shelf life of cherry tomato fruits was decided based on the appearance and spoilage of fruits. When 50 per cent of fruits showed symptoms of shrinkage or spoilage due to pathogens and chilling injury, that lots of fruit were considered to have reached end of shelf life. Shelf life was also measured according to visual quality (≥3; good, marketable) and determinants such as mold growth, decay, shriveling, smoothness, shininess, and homogeneity (Rashid and Rahman, 2020; Rashid *et al*., 2015).

Statistical analysis
The collected data on various parameters were statistically analyzed using MSTATC statistical package. That means for all the treatments were calculated and analysis of variance (ANOVA) for all the parameters was perfected by F-test. The significance difference between pair of means was by least significant difference (LSD) test at 1 and 5% levels of probability (Gomez and Gomez, 1984).

Results and Discussions
External appearance and color
The cherry tomato treated with garlic extracts is maximum color change and the cherry tomato with hot water (50°C for 5 mins.) + Chitosan coating (0.2%) is minimum change on the others treatment combination. For Binatomato 10, the highest color was found in fruits treated with garlic extracts solution (3.00, 4.67, 5.33, 5.67, 6.67, 7.33 score points) at 3rd, 6th, 9th, 12th, 15th and 18th days after storage while the lowest color was observed with hot water + Chitosan coating (3.00, 4.00, 4.33, 4.67, 5.00, 5.67 score points) at 3rd, 6th, 9th, 9th, 12th, 15th and 18th days after storage as compared to other treatments (Table 1). For BARI Tomato 11, the highest color was found in fruits treated with garlic extracts solution (3.00, 5.00, 5.67, 6.00, 7.00, 8.00 score points) at 3rd, 6th, 9th, 12th, 15th and 18th days after storage while the lowest color was observed with hot water + Chitosan coating (3.00, 4.33, 4.67, 5.00, 5.67, 6.33 score points) at 3rd, 6th, 9th, 9th, 12th, 15th and 18th days after storage as compared to other treatments.

Table 1. Combined effects of varieties and postharvest treatments on color change at different days after storage of cherry tomato.

Treatment combination	Color at different days after storage					
	3	6	9	12	15	18
V_1T_0	3.00	4.33	5.00	5.33	5.70	6.67
V_1T_1	3.00	4.00	4.67	5.33	5.67	6.33
V_1T_2	3.00	4.67	5.33	5.67	6.67	7.33
V_1T_3	3.00	4.00	4.33	4.67	5.00	5.67
V_1T_4	3.00	4.33	4.67	4.70	5.33	6.00
V_2T_0	3.00	4.67	5.00	5.33	6.33	7.33
V_2T_1	3.00	4.33	5.33	5.67	6.67	6.67
V_2T_2	3.00	5.00	5.67	6.00	7.00	8.00
V_2T_3	3.00	4.33	4.67	5.00	6.00	6.33
V_2T_4	3.00	4.67	4.67	5.33	6.33	7.00
$LSD_{0.05}$	-	0.48	0.22	0.12	0.19	0.15
$LSD_{0.01}$	-	0.65	0.30	0.16	0.25	0.21
Level of significance	-	NS	**	**	**	**

** = Significant at 1% level of probability, NS = Not significant, V_1 = Binatomato 10, V_2 = BARI Tomato-11 (Jhumka), T_0 = Control, T_1 = Chitosan Coating (0.2%), T_2 = Garlic extracts (1:1), T_3 = Hot water (50°C for 5 mins.) + Chitosan coating (0.2%), T_4 = Hot water (50°C for 5 mins.) + Garlic extracts (1:1).

Figure 1. Photograph showing the differences in external appearance and colour of cherry tomato under different postharvest treatments at 3 DAS.

Figure 2. Photograph showing the differences in external appearance and colour of cherry tomato under different postharvest treatments at 6 DAS.

Figure 3. Photograph showing the differences in external appearance and colour of cherry tomato under different postharvest treatments at 9 DAS.

Figure 4. Photograph showing the differences in external appearance and colour of cherry tomato under different postharvest treatments at 12 DAS.

Figure 5. Photograph showing the differences in external appearance and colour of cherry tomato under different postharvest treatments at 15 DAS.

Figure 6. Photograph showing the differences in external appearance and colour of cherry tomato under different postharvest treatments at 18 DAS.

Weight loss (%)

The Combined effects of varieties and postharvest treatment on percent weight loss lower at different days after storage of cherry tomato is lower with hot water + Chitosan coating and higher at control (Table 2). Totally the weight loss is increasing day after storage. After starting time the rate of percentage is high and some days later the rate of percentage weight loss slightly decrease respectively at 3rd, 6th, 9th, 12th, 15th and 18th days of storage. This could be due to increase the rate of physiological process like transpiration and respiration Mustafa and Mughrabi (1994) and Badshah *et al.* (1997) in tomato. This is mainly attributed to continuous moisture and other nutrient loss as the cherry tomato fruits are alive (Nirupama, *et al.*, 2010).

For Binatomato 10, with respect to the postharvest treatments the lowest weight loss throughout the storage period was found in the fruits treated with hot water + Chitosan coating (0.94, 1.83, 2.63, 3.94, 4.86, 5.93%) followed by cherry tomato at 3rd, 6th, 9th, 12th, 15th and 18th days of storage, respectively (Table 2). While the highest weight loss was found in fruits without any treatment that means control (1.33, 2.37, 3.89, 5.71, 6.63, 7.69%) at 3rd, 6th, 9th, 12th, 15th and 18th days of storage, respectively. The lowest weight loss in fruits was recorded in fruits treated with hot water + Chitosan coating and without treatment increase weight loss day by day.

For BARI Tomato 11, with respect to the postharvest treatments the lowest weight loss throughout the storage period was found in the fruits treated with hot water + Chitosan coating (1.10, 2.50, 3.39, 5.05, 6.31, 7.83%) followed by cherry tomato at 3rd, 6th, 9th, 12th, 15th and 18th days of storage, respectively (Table 2). While the highest weight loss was found in fruits treated with Garlic extracts (1.44, 2.52, 3.86, 5.49, 7.34, 8.93%) followed by cherry tomato at 3rd, 6th, 9th, 12th, 15th and 18th days of storage respectively. This could be attributed to the fact that postharvest treatments viz. garlic extracts solution & chitosan solution created a surface layer over the fruit which protected from weight loss. It was observed that fruit act as a physical barrier for transpiration losses. Gheyas and Haque (1989) reported that weight loss in banana fruits during the period from harvest to ripening may be attributed by respiration and loss of water though transpiration.

Table 2. Combined effects of varieties and organic postharvest treatments on weight loss and firmness at different days after storage of cherry tomato.

Treatment combination	Weight loss (%) at different days after storage						Firmness at different days after storage			
	3	6	9	12	15	18	9	12	15	18
V_1T_0	1.33	2.37	3.89	5.71	6.63	7.69	1.31	2.00	3.33	4.00
V_1T_1	1.33	2.18	3.60	4.76	6.14	7.11	0.67	1.00	1.67	2.33
V_1T_2	1.29	2.38	3.56	4.40	5.64	6.77	1.67	2.33	3.67	4.67
V_1T_3	0.94	1.83	2.63	3.94	4.86	5.93	0.33	0.67	1.00	2.00
V_1T_4	1.36	2.26	3.37	4.35	5.63	6.52	0.67	1.00	1.33	2.00
V_2T_0	1.53	3.32	4.56	6.21	7.06	8.57	0.67	2.33	3.33	4.33
V_2T_1	1.34	3.18	4.54	6.07	6.93	8.45	1.67	1.00	1.67	2.33
V_2T_2	1.44	2.52	3.86	5.49	7.34	8.93	0.33	2.67	4.00	5.33
V_2T_3	1.10	2.50	3.39	5.05	6.31	7.83	0.67	1.00	1.33	1.67
V_2T_4	1.49	2.95	4.11	6.09	6.85	8.20	0.33	1.33	2.00	2.33
$LSD_{0.05}$	0.08	0.21	0.12	0.27	0.32	0.33	0.20	0.14	0.26	0.22
$LSD_{0.01}$	0.10	0.28	0.16	0.37	0.44	0.45	0.27	0.19	0.35	0.30
Level of significance	**	**	**	**	**	**	**	**	**	**

** = Significant at 1% level of probability, V_1 = Binatomato 10, V_2 = BARI Tomato-11 (Jhumka), T_0 = Control, T_1 = Chitosan Coating (0.2%), T_2 = Garlic extracts (1:1), T_3 = Hot water (50°C for 5 mins.) + Chitosan coating (0.2%), T_4 = Hot water (50°C for 5 mins.) + Garlic extracts (1:1).

Firmness (kg/cm^2)

The Combined effects of varieties and postharvest treatment on percent firmness loss lower at different days after storage of cherry tomato is lower at hot water + Chitosan coating and higher at garlic extracts solution (Table 2). Among postharvest treatments, for Binatomato 10, the maximum firmness throughout the period at storage days was found in the cherry tomato fruits treated with garlic extracts (1.67, 2.33, 3.67, 4.67 kg/ cm^2) at 9th, 12th, 15th and 18th days of storage respectively. While the minimum firmness was found in cherry tomato fruits with treatment hot water + Chitosan coating (0.33, 0.67, 1.00, 2.00 kg/cm^2) and hot water + Garlic extracts (0.67, 1.00, 1.33, 2.00 kg/cm^2) at 9th, 12th, 15th and 18th days of storage respectively. For BARI Tomato-11, the maximum firmness throughout the period at storage days was found in the cherry tomato fruits treated with garlic extracts (0.33, 2.67, 4.00, 5.33 kg/cm^2) at 9th, 12th,15th and 18th days of storage respectively. While the minimum firmness was found in cherry tomato fruits with treatment hot water + Chitosan coating (0.67, 1.00, 1.33, 1.67 kg/cm^2) at 9th, 12th, 15th and 18th days of storage respectively. This could be due to increase in the rate of physiological process like transpiration and respiration. This is mainly attributed to continuous moisture and other nutrient loss as fruits are alive (Nirupama *et al*., 2010).

Total soluble solids (TSS)

The Combined effects of varieties and postharvest treatment on percent TSS is gradually increase all the interaction firstly and maximum is (8.53%) in hot water + Garlic at 6 DAS for BARI Tomato 11 but after a day later the pH is decrease and the minimum (6.13%) at 18 DAS of cherry tomato treated with hot water + Chitosan coating (Table 3). The TSS of tomato increase by ripening of fruits but after certain level is decrease dramatically. This could be attributed due to the increase in TSS of cherry tomato fruits ripening, softer and sweeter, corresponding decrease in acidity caused by degradation of acids during ripening and senescence. Similarly, the increase of TSS could be attributed to conversion of starch and other in soluble compounds (Wasker and Nikam, 1997) in sapota, Sudhir Yadav *et al.* (2005), and Mahajan and Sharma (2000) in peach. Total soluble solids increased throughout the fruit development in tomato.

Table 3. Combined effects of varieties and organic postharvest treatments on TSS (% brix) at different days after storage of cherry tomato.

Treatment combination	TSS (%brix) at different days after storage						Pulp pH at different days after storage					
	3	6	9	12	15	18	3	6	9	12	15	18
V_1T_0	8.13	8.27	7.80	7.33	6.90	6.60	5.93	5.93	5.97	6.27	6.05	6.12
V_1T_1	8.00	8.00	7.73	7.50	6.97	6.60	6.00	6.13	6.13	6.23	6.21	6.25
V_1T_2	8.33	8.43	7.83	7.67	7.40	6.43	6.07	5.95	5.98	6.12	6.15	6.17
V_1T_3	7.70	7.87	7.60	7.27	6.70	6.13	6.17	6.13	6.20	6.27	6.39	6.40
V_1T_4	8.27	8.37	7.67	7.43	6.63	6.13	6.17	6.13	6.31	6.26	6.35	6.45
V_2T_0	8.50	8.67	8.03	7.80	7.40	6.73	6.21	6.17	6.15	6.21	6.12	6.22
V_2T_1	8.27	8.43	8.13	7.63	7.40	6.97	6.23	6.21	6.25	6.23	6.19	6.20
V_2T_2	8.33	8.50	8.10	7.87	7.60	7.00	6.11	6.12	6.15	6.22	6.26	6.45
V_2T_3	8.53	8.63	8.13	7.43	7.57	6.83	6.22	6.26	6.34	6.33	6.37	6.43
V_2T_4	8.43	8.53	8.33	7.70	7.50	7.07	6.23	6.26	6.33	6.36	6.40	6.49
$LSD_{0.05}$	0.18	0.30	0.14	0.12	0.29	0.27	0.034	0.038	0.038	0.038	0.051	0.034
$LSD_{0.01}$	0.24	0.40	0.19	0.16	0.40	0.37	0.046	0.052	0.052	0.052	0.070	0.046
Level of significance	**	*	**	**	**	**	**	**	**	**	**	**

**, * = Significant at 1 and 5% levels of probability, V_1 = Binatomato 10, V_2 = BARI Tomato-11 (Jhumka), T_0 = Control, T_1 = Chitosan Coating (0.2%), T_2 = Garlic extracts (1:1), T_3 = Hot water (50°C for 5 mins.) + Chitosan coating (0.2%), T_4 = Hot water (50°C for 5 mins.) + Garlic extracts (1:1).

Pulp pH

The combined effect of varieties and postharvest treatments on pH was significant at 3rd, 6th, 9th, 15th and 18th days after storage (Table 3). The highest pH (6.23) in V_2T_2 and the lowest (5.93) was recorded in V_1T_0 at 3 days after storage. At 6 DAS the maximum pH (6.26) in V_2T_2 and the minimum (5.93) was observed in V_1T_0. At 9 DAS the longest pH (6.34) in V_2T_0 and the minimum (5.97) was found in V_1T_0. At 12 DAS the highest pH (6.36) in V_2T_2 and the lowest (6.12) was recorded in V_1T_0. At 15 DAS the maximum pH was observed (6.40) in V_2T_2 and the minimum (5.93) was observed in V_1T_0. At 18 DAS the maximum pH was observed (6.49) in V_2T_2 and the minimum (6.12) was observed in V_1T_0 respectively (Table 5). This could be attributed, the increase in pH of fruit during ripening, corresponding decrease in acidity caused by degradation of acids during ripening and senescence (Rashid and Habib, 2019).

Disease incidence (%)

The postharvest treatments exhibited highly significant effect on the percent disease incidence during storage of cherry tomato (Table 4). At 18 DAS, the highest percent disease incidence was identified in Binatomato 10 which treated with garlic extracts solution (12.33%) and the lowest was 3.67% which treated with hot water+ Chitosan coating in room temperature. For the BARI Tomato-11, the highest percent disease incidence was 12.67% which treated with garlic extracts solution due to fungal attack and lowest was 4.67% which treated with hot water + Chitosan coating. Due to chitosan coating hot water treatment, we showed low amount microbial attack or fungal attack, which is very preferable for the consumers and local market. A significant difference showed with treatments, varieties and their interaction (Zhu *et al*., 2008).

Table 4. Combined effects of varieties and organic postharvest treatments on disease incidence (%) at different days after storage of cherry tomato.

Treatment combination	Disease incidence (%) at different days after storage					Disease severity (%) at different days after storage				
	6	9	12	15	18	6	9	12	15	18
V_1T_0	0.44	4.67	6.67	9.33	11.33	6.67	10.67	13.33	16.67	19.67
V_1T_1	0.33	3.33	4.33	5.67	7.00	4.33	6.67	8.67	10.67	12.67
V_1T_2	0.00	4.00	5.67	10.00	12.33	5.67	7.33	11.33	14.67	21.67
V_1T_3	0.00	0.00	0.33	2.67	3.67	0.00	0.00	1.67	2.67	3.57
V_1T_4	0.33	2.67	3.67	4.33	5.67	0.00	1.67	2.33	3.67	5.67
V_2T_0	0.33	4.33	6.00	8.67	12.33	6.33	7.67	11.33	14.67	21.67
V_2T_1	0.00	4.67	5.33	7.00	8.67	4.67	6.00	7.67	9.33	11.67
V_2T_2	0.33	5.00	7.33	9.33	12.67	7.00	8.67	12.00	12.33	19.00
V_2T_3	0.00	1.00	2.33	3.67	4.67	3.67	5.67	6.67	7.67	8.33
V_2T_4	0.33	2.67	3.33	4.67	6.33	4.67	6.33	8.33	9.33	11.67
$LSD_{0.05}$	0.05	0.70	0.62	0.57	0.50	0.51	0.51	0.78	0.78	1.54
$LSD_{0.01}$	0.07	0.95	0.85	0.78	0.69	0.69	0.70	1.07	1.06	2.10
Level of significance	**	**	**	**	**	**	**	**	**	**

**= Significant at 1% level of probability. V_1 = Binatomato 10, V_2 = BARI Tomato-11 (Jhumka), T_0 = Control, T_1 = Chitosan Coating (0.2%), T_2 = Garlic extracts (1:1), T_3 = Hot water (50°C for 5 mins.) + Chitosan coating (0.2%), T_4 = Hot water (50°C for 5 mins.) + Garlic extracts (1:1).

Disease severity (%)

The storage treatments used in the investigation had highly significant effects on (21.67%) disease severity was investigated in Binatomato 10 which treated garlic extracts solution and low disease severity was observed in treated hot water + Chitosan coating (3.67%) (Table 4).

For BARI Tomato-11, the highest percent disease severity was 21.67% in control fruits and lowest was 8.33% which treated with hot water + Chitosan coating. This could be attributed to postharvest treatment which is contributed to the strengthening the cell wall and skin of fruit so that micro-organism cannot get enter to spoilage the cherry tomato fruits. Our observation was confirmed by Nirupama *et al.* 2010) in tomato, Vishalnath and Bhargava (1998) in ber fruits and Moneruzzaman *et al.* (2009) in tomato.

Dry matter content

For Binatomato 10, with respect to the postharvest treatments the dry matter contents were found in the fruits treated with treatments (5.90, 6.11, 6.16, 6.04, 5.89%). While the highest weight loss was found in fruits with garlic extracts treatment and the lowest dry matter content in fruits was recorded in fruits treated with hot water + Garlic extracts due to boiled before treated with garlic extracts solution. For BARI Tomato-11, with respect to the postharvest treatments the dry matter contents were found in the fruits treated with treatments (5.55, 6.49, 6.37, 5.88, 5.04%). While the highest weight loss was found in fruits with chitosan coating treatment and the lowest dry matter content in fruits was recorded in fruits treated with hot water + Garlic extracts due to boiled before treated with garlic extracts solution (Rashid *et al.*, 2019).

Table 5. Combined effects of varieties and organic postharvest treatments on dry matter content and shelf life of cherry tomato.

Treatment combination	Dry matter content (%)	Shelf life (days)
V_1T_0	5.90	17.67
V_1T_1	6.11	23.67
V_1T_2	6.16	18.00
V_1T_3	6.04	31.00
V_1T_4	5.89	24.33
V_2T_0	5.55	15.67
V_2T_1	6.49	21.67
V_2T_2	6.37	14.33
V_2T_3	5.88	27.00
V_2T_4	5.05	24.00
$LSD_{0.05}$	0.34	1.172
$LSD_{0.01}$	0.46	1.578
Level of significance	**	**

**= Significant at 1% level of probability. V_1 = Binatomato 10, V_2 = BARI Tomato-11 (Jhumka), T_0 = Control, T_1 = Chitosan Coating (0.2%), T_2 = Garlic extracts (1:1), T_3 = Hot water (50°C for 5 mins.) + Chitosan coating (0.2%), T_4 = Hot water (50°C for 5 mins.) + Garlic extracts (1:1).

Shelf life

Data revealed that there was a significant difference between the treatments as influenced by the postharvest treatments and their interactions. For Binatomato 10, the longest shelf life (31 days) was recorded in fruits with hot water + Chitosan coating combination at room temperature and minimum shelf life (17 days) was recorded in control treatment. For BARI Tomato-11, the longest shelf life (27 days) was recorded in fruits with hot water + Chitosan coating combination at room temperature and minimum shelf life (14.33 days) was recorded in garlic extracts solution treatment due to less fungal attack and slowing of physiological process which increased shelf life (Rashid and Rahman, 2020).

Conclusion

Shelf life is the basic quality of fruits, which helps marketing duration, and it is the most important aspect in loss reduction technology of fruits (Rashid *et al*., 2015). Results indicated that significant variation existed due to the effect of varieties and postharvest treatment. From the present study it was found that the V_2 (Binatomato 10) was better shelf life and quality retention of cherry tomato followed by V_2 (BARI Tomato-11). Among the five postharvest treatment the hot water + Chitosan coating was better shelf life and quality retention of cherry tomato followed by hot water + Garlic extracts, chitosan coating, garlic extracts. And the combined effect it may be concluded that best shelf life and quality retention of cherry tomato was obtained in V_1T_3 (Binatomato 10 treated with hot water + Chitosan coating treatment). Therefore, it may be concluded that cherry tomato fruits under variety Binatomato 10 along with the application hot water + Chitosan coating could be used to reduce postharvest fungal infection, shelf life extension and quality retention of cherry tomato.

Acknowledgements

The authors are thankful to the Bangladesh Agricultural University Research System (BAURES) for funding this work (Project no. 2019/773/BAU).

References

Badshah N, Muhammad S., Qaim M, Ayaz S (1997). Shelf life study in tomato storage with different packaging materials. *Sarhad J. Agric.* 13(4): 347-350.

BAU (2013). Post-harvest losses need to be minimized, Newsletter April–June, BAU 11(2).

FAO (2003). Diet, nutrition and the preservation of chronic disease. Report of a joint FAO/WHO, Expert Consultation, WHO Technical Report Series 916, Geneva.

Firmin A (1997). Physico-chemical changes in papaya during storage. *Tropic. Sci.* 37(1): 49–51.

Gheyas F, Haque MA (1989). A competitive study on change in physiochemical parameters during ripening of four cultivates of banana. *Bangladesh J. Agric. Res.* 17(1): 25-32.

Gomez KA, Gomez AA (1984). Statistical procedures for agricultural research. John Wiley and Sons.

Hassan MK (2010). Final report-postharvest loss assessment: a study to formulate policy for loss reduction of fruits and brinjal and socio-economic uplift of the stake holders (Funded by USAID and EC and Jointly Implemented by FAO and FPMU of MoFDM). pp. 189.

Hossain MD (2000). A study on marketing of some winter vegetables produced in selected areas of Bangladesh. MS thesis. *Department of Horticulture, Bangladesh Agricultural University, Mymensingh pp.* 131.

Kabir HF, Sabir FK (2018). Chitosan coating for extending postharvest quality of tomatoes (*Lycopersicon esculentum* Mill.) maintained at different storage temperatures.

Kobryn J, Hallmann E (2005). The effect of nitrogen fertilizer on the quality of three tomato types cultivated on Rockwool. *Acta Hort.* 691: 341-348.

Lanza GE, di Martino Aleppo, Strano MC, Reforgiato Recupero G (2000). Evaluation of hot water treatments to control postharvest green mold in organic lemon fruit, pp. 1167-1168. In: Proc. Intl. Soc. Citricult XI Congr., Orlando, 3-7 Lougheed EC, Murr DP, Berard

L (1978). Low pressure storage for horticultural crops. *Hort. Sci.* 13: 21-27.

Mahajan BVC, Sharma RC (2000). Effect of pre harvest application of growth regulators and calcium chloride on physicochemical characteristics and storage life of peach Cv. Shane-e Punjab. *Hariyan J. Hort. Sci.* 29(1-2): 41-43.

Moneruzzaman KM, Hossain AB, Sani W, Saifuddin M (2009). The effect of harvesting and storage conditions on the postharvest quality of tomato (*Lycopersicon* esculentum Mill) cv. Roma VF. *Australian J. Food Crops* 3: 113-121.

Mustafa A, Mughrabi AL (1994). Effect of packaging methods on the quality characteristics of tomato fruits produced in hydroponics. *J. King Saud Univ.* 6: 71-76.

Nesbitt TC, Tanksley SD (2002). "Comparative sequencing in the genus Lycopersicon. Implications for the evolution of fruit size in the domestication of cultivated tomatoes" (https://www.ncbi.nlm.nih.gov/pmc/articles/PMC1462239). *Genetics* 162: 365–79. PMC 1462239 (https://www.ncbi.nlm.nih.gov/pmc/articles/PMC1462239). PMID 12242247(https://www.ncbi.nlm.nih.gov/pubmed/12242247).

Nirupama P, Neeta BG, Ramana rao TV (2010). Effect of postharvest treatments on physicochemical characteristics and shelf life of tomato (*Lycopersicon esculentum* Mill.) fruits during storage. *American-Eurasian J. Agric. Environ. Sci.* 9: 470-479.

Pila N, Gol NB, Rao TVR (2010). Effect of postharvest treatments on physicochemical characteristics and shelf life of tomato (*Lycopersicon esculentum* Mill.) fruits during storage. *American-Eurasian J. Agric. Environ. Sci.* 9(5): 470–479.

Ranganna S (1994). Manual of Analysis of Fruit and Vegetable Products’, Tata McGraw -Hill Pub. Co. Ltd., New Delhi 634.

Rashid MHA, Borman BC, Hasna MK, Begum HA (2019). Effect of non-chemical treatments on postharvest diseases, shelf life and quality of papaya under two different maturity stages. *J. Bangladesh Agric. Univ.* 17(1): 14-25. https://doi.org/10.3329/jbau. v17i1.40658

Rashid MHA, Grout BWW, Continella A, Mahmud TMM (2015). Low-dose gamma irradiation following hot water immersion of papaya (*Carica papaya* Linn.) fruits provides additional control of postharvest fungal infection to extend shelf life. *Rad. Phys. Chem.* 110: 77–81. https://doi.org/10.1016/j.radphyschem.2015.01.024

Rashid MHA, Habib MA (2019). Effects of Maturity Stages and Organic Treatments to Control Postharvest Fungal Infection, Shelf life Extension and Quality Retention of Papaya for Nutritional Food Safety. Proceedings of International Symposium on a New Era in Food Science and Technology 2019. The United Graduate School of Agricultural Sciences, Gifu University, Japan, p. 83-88.

Rashid MHA, Rahman MA (2020). Effects of modified atmosphere packaging (MAP) and natural edible coatings on controlling postharvest fungal infection, shelf life extension and quality retention of strawberry (*Fragaria* × *ananassa* Duch.). *J. Agric. Food Environ.* 1(3): 14-23.

Rosales MA, Cervilla LM, Sánchez-Rodríguez E, Rubio-Wilhelmi Mdel M, Blasco B (2011). The effect of environmental conditions on nutritional quality of cherry tomato fruits: evaluation of two experimental Mediterranean greenhouses. *J. Food Agric. Sci.* 91: 152-162.

Sheikh RA *et al*. (2013). Chitosan as a Novel Edible Coating for Fresh Fruits. *Food Sci. Tech. Res.* 19 (2): 139-155.

Sudhir Yadav, Ashwanikumar, Salni RS (2005). Bio chemical and organoleptic quality changers during storage of ber fruit transported with different packaging material. *Hariyana J. Hort. Sci.* 34 (1-2): 25-28.

Vishalnath, Bhargava R (1998). Shelf life of Ber (*Ziziphus marutinia*) as affected by postharvest treatments and storage environment. *Progress. Hort.* 30(2-4): 158-163.

Waskar DP, Nikam SK (1997). Methods adopted for extending the shelf-life of sapota fruit. *Indian food packer* 15 (4): 45-51.

Zhu X, Wang QM, Cao JK, *et al*. (2008). Effects of chitosan coating on postharvest quality of mango (*Mangifera indica* L. cv. Tainong) fruits. *J. Food Process. Press* 32: 770–784.