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Review on: Effect of Pre and Post Harvest Treatment on the Quality of Tomato (*Lycopersicon esculentum* L.)

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Abstract

Tomato is one of the most popular produced and extensively consumed vegetable crops in the world and belongs to Solanceace family. Tomato production can serve as a source of income for most rural and per urban producers in most developing countries of the world. However, postharvest losses make its production unprofitable in these parts of the world. Postharvest losses in tomatoes can be as high as 25- 42% globally. Postharvest losses in tomatoes can be either quantitative or qualitative. The postharvest quality status of tomatoes partly depended on some preharvest practices carried out during production some of these factors are climate, fertilizer application, pruning, maturity stage, cultivar selection, and irrigation and also using best postharvest handling practices or factors such as temperature, relative humidity, gases in storage, postharvest calcium chloride application, and physical handling procedures to maintain the quality after harvest was also critical.The potential for solving some of the problems related to tomato quality and its postharvest maintenance through excellent genetic manipulations by plant breeders and work improving the nutritional quality and technology of modified atmospheres application within consumer packages, pallets, and transport vehicles a high priority in future research. The main objective of this seminar paper is to review effect of preharvest and postharvest factors affecting the quality and shelf life of harvested tomatoes.

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Introduction

Tomato (*Lycopersicon esculentum*) is one of the vegetable crops with the highest production in the world and its production is increasing all over the world. Tomato is rich in minerals, vitamins, essintial amino acids, sugare and dietary fibers (Ayandiji *et al.*,2011) world tomato production in 2001 was about 105 million tons of fruit from an estimated 3.4 million ha.as it is a relatively short duration crop and gives a high yield it is economically attractive and the area under cultivation is increasing daily. Tomato is an annual plant. which can reach a height of over two meters. The first harvest is possible 45-55 days after flowering or 90-120 days after sowing the shape of the fruit differs per cultivar. The colour ranges from yellow to red 2011. Tomato is one of the most popular produced and extensively consumed vegetable crops in the world and belongs to Solanceace family (Freeman and Reamers, 2011). It is originated in the Andes Mountains of Peru, from where it spread as a weed to extensive areas in South and Central America (Colla *et al.*, 2002). Tomatoes can be consumed in many ways. The fresh fruits are eaten in salads and sandwiches and as salsa whilst the processed ones are consumed dried or as pastes, preserves, sauces, soups, juices, and drinks (Tanweer and Goyal, 2007). Tomato contains higher amounts of lycopene, a type of carotenoid with antioxidant properties which is beneficial in reducing the incidence of some chronic diseases like cancer and many other cardiovascular disorders (Arab and Steck, 2000).

In regions where it is being cultivated and consumed, it constitutes a very essential part of peoples diet. Tomatoes production accounts for about 4.8 million hectares of harvested land area globally with an estimated production of 162 million tonnes. China leads world tomato production with about 50 million tonnes followed by India with 17.5 million tones. Tomato production can serve as a source of income for most rural and per urban producers in most developing countries of the world (Arah *et al.*, 2015). Despite the numerous benefits that can be derived from the crop, postharvest losses make its production in most parts of the world unprofitable. Postharvest losses in tomatoes can be as high as 25–42% globally (Rehman *et al.*, 2007). These losses bring low returns to growers, processors, and traders as well as the whole country which suffers in terms of foreign exchange earnings properly will reduce the postharvest quality losses in tomatoes.

Postharvest losses in tomatoes can be either quantitative or qualitative. Even though emphasis in crop research nowadays is increasing shifting from quantity to quality of produce (Oko-Ibom and Asiegbu, 2007). There is still little improvement in the quality of commercially produced tomato varieties, hence resulting in high amount of qualitative losses. However, qualitative loss in tomato production can have a negative impact on many parameters like consumer acceptability, nutrient status of fruits, and financial income to producers. The postharvest qualities of tomatoes are dependent not only on postharvest handling and treatment methods but also on many preharvest factors such as genetic and environmental conditions (Hobson, 2008).

Many cultural practices such as types of nutrient, water supply, and harvesting methods are also believed to be factors influencing both pre- and postharvest quality of tomato (Melkamu *et al.,* 2008). Tomato fruits that are diseased and infected by pest, inappropriately irrigated, and fertilized or generally of poor quality before harvesting can never be improved in quality by any postharvest treatment methods (Booth, 2004). This indicates that the postharvest quality of the fruit cannot be improved after harvest but can only be maintained. It is therefore important to know the preharvest factors that can produce superior qualities in fruits during harvest whilst using appropriate postharvest handling and treatment methods to maintain the quality after harvest.

Objective

To review the effect of pre-harvest and post-harvest treatment on the quality of tomato

Botany of tomato

The tomato is a dicotyledonous, herbaceous, with flexible hairy stem and soft when young, becoming fibrous and angular with the passage of time. The leaves measure 11 to 32 cm in length and are composed of an odd number of leaflets. They are alternated and petiolate, of oval to oblong form. It is a plant of habit of indeterminate or determined growth, depending on the cultivar (Filgueira, 2012). The root system is composed of main root, secondary and adventitious. The main or pivotal root can reach 5 m depth, depending on soil type and genotype. Secondary’s are stimulated when the main and adventitious root undergo stress in transplant. In general, 70% of the root system is in the first 20 cm of the soil surface (Puiatti, 2010).

Effect of pre-harvest factors on post-harvest quality of tomatoes and its shelf life

The shelf life was calculated by counting the days required to attain the last stage of ripening but up to the stage when fruit remained still acceptable for consumption or marketing i.e when 40 per cent of fruits showed symptoms of spoilage the fruits were considered to have reached end of the shelf life (Rai *et al.*, 2012) after harvesting the fruit still remains alive and perform all function of aliving tissue. the climacteric burst of ethlene which makes the fruit palatable also triggers swnescencs and subsequent ripening in the fruit. the goal of any postharvest handling practice or treatment is to manage to concentration and timing of ethylene synthesis to that the fruit reaches the consumer at optimal eating quality.

Maturity stage

The maturity stage of tomato fruit at harvest is an important determinant of many quality traits.(Beckles, 2012). Tomato, being a climacteric fruit, can be harvested at different stages during maturity, like mature green, half ripen, or red ripen stage depending on the market and production area. Each stage at harvest has its own postharvest attribute that the fruit will exhibit. Moneruzzaman *et al.*, (2006) reported that the shelf life of all tomato cultivars under investigation is longest when harvested at green mature stage and also Fruit nutritional values and appearance may be affected when harvested green.

For instance, sugar transport to fruits in a vine-ripened tomato appears to increase during the latter part of maturity and, therefore, when fruits are harvested immature or in a green state sugar import to fruits will be cut off making postharvest degradation of starch, the main source of carbohydrates, which is both undesirable and inadequate (Toivonen 2007). Meanwhile, harvesting later also promotes higher sugar accumulation in riper fruits which are susceptible to mechanical injuries with a shorter shelf life (Cliff, and, Toivonen 2009). The pH of tomatoes is an important parameter in the tomato processing industry.

Tomatoes are processed as high-acid foods and therefore the higher the acidity the better for processing. Cultivars with high pH therefore may not be suitable for processing. A pH of 4.4 has been suggested to be the maximum and the optimum of a target of 4.25 the acidity of tomatoes is highest at the pink stage of maturity with a rapid decrease as the fruit ripens (Getinet *et al.,* 2011). Cliff *et al.*, 2006, suggested tomato fruits can be harvested at mature green to give producers enough time for long distance marketing but for local marketing harvesting at the fully ripe stage is preferred to maximize nutritional value (Table 1 and 2).

Total soluble solids were increased; whereas fruit firmness decreased with increasing harvesting stages. Weight loss percentage, postharvest decay percentage and shelf life increased; while fruit firmness decreased with increasing storage period (Kader, 1984).

Method of harvesting in relation to physical damage and uniformity of maturity

The method of harvesting (hand vs. mechanical) can significantly impact upon the composition and post-harvest quality of tomato fruit. Mechanical injuries (such as bruising, surface abrasions and cuts) can accelerate loss of water and vitamin C resulting in increased susceptibility to decay-causing pathogens (Singh *et al.*, 2003) (Table 3).

Cultivar type

The potential quality of fruit is dependent on the cultivar type. Different cultivars are characterized by different quality parameters making some more desirable to the producers and consumers than others **(**Getinet *et al.*, 2011). The choice of an adequate-yielding tomato cultivar with desired fruit qualities and longer shelf life is therefore a vital decision a producer must taken. Failure to select an appropriate cultivar may lead to lower yield, low quality fruits, or less market acceptability. Fruits of different cultivars differ in size, colour, texture, and flavour as well as storage potential Getinet *et al.*, (2011).

According to Getinet *et al.,* (2011) Tomato cultivar Roma VF has higher sugar content whilst maintaining lower weight loss as compared to cultivar Marglobe. Cultivar selection is therefore critical to the postharvest storage life and eating qualities of tomatoes.

Irrigation

Tomato is not a drought resistant crop and therefore yields decrease considerably after short periods of water deficiency during production. Proper irrigation scheduling in tomato production is therefore crucial to the crop development. However, with water being a scarce resource in most production areas, growers in recent years have therefore had to develop a more efficient water management scheme that maintains crop yield but has a moderate and controlled level of moisture stress on their crops Nuez, 2001. Mitchell *et al.*, 2007, deficit irrigation reduced fruit water accumulation and fresh fruit yield but increased fruit total soluble solids levels and also irrigating with saline water had no significant effect on total fruit yield but moisture content of fruits was slightly reduced.

Ismail *et al.*, 2008, also reported that tomato can be irrigate in early morning every three days resulted in higher yields than daily irrigation. The use of trace elements or the practice of soilless tomato production can be made possible during irrigation where the fertilizers (trace elements) are added to the irrigation water in a form of solution and administered. These trace elements are selected depending on the specific postharvest quality traits needed in the fruits.

Effect of postharvest factors on postharvest quality of tomatoes and its shelf life

After harvesting, the fruit still remains alive and performs all functions of a living tissue. The climacteric burst of ethylene which makes the fruit palatable also triggers senescence and subsequent ripening in the fruits. The goal of any postharvest handling practice or treatment is to manage the concentration and timing of ethylene synthesis so that the fruit reaches the consumer at optimal eating quality (Beckles, 2012).

According to Peppelenbos (2007) Post harvest quality represents market quality, edible quality, transport quality, table quality, nutritional quality, internal quality and appearance quality. Quality means a combination of characteristics, attributes and properties that gives the values to human and enjoyments. Consumers consider good quality in relation to colour, flavour and nutrition. Quality of the produce is the final manifestation of inter-relation between the commodity and its environment (Table 4–6).

Temperature

Proper temperature management between the period of harvesting and consumption has been found to be the most effective way to maintain quality. Keeping harvested fruits cool at low temperatures of about 20°C will slow down many metabolic activities which lead to ripening, hence allowing more time for all the postharvest handling of the produce (Otma, 2003).

Respiration and metabolic activities within harvested climacteric fruits like tomatoes are directly related to the temperatures of the ambient environment. High temperatures can hasten the rate of respiration (CO2 production) in harvested or stored fruits products. CO2 production in stored climacteric products like tomatoes can trigger ethylene production although this depends on other factors like O_2 or CO_2 levels, exposure time, and ripening stage (Raison, and, Lyons, 2006)

Low temperature storage can protect nonappearance quality attributes like texture, nutrition, aroma, and flavor (Pranamornkith, and. Heyes 2012).Meanwhile, tomato being a tropical fruit is also adversely affected by exposure to extremely low temperatures. Chilling injury can occur in tomato fruits stored at temperatures below 10°C (Grossmann, and Verhe, 2009) .The effect of chilling injury includes premature softening, irregular colour development, surface pitting, browning of seeds, water-soaked lesions, off-flavour development, and increased postharvest decay (Cantwell, 2009).

Relative humidity

Water loss from harvested fruit produce is predominantly caused by the amount of moisture present in the ambient air expressed as relative humidity (Gómez, and Artés-Hernández 2006).At very high relative humidity, harvested fruits maintain their nutritional quality, appearance, weight, and flavour, whilst reducing the rate at which wilting, softening, and juiciness occur. Tomato fruits are very high in water content and susceptible to shrinkage after harvest. Fruit shrivel may become evident with any small percentage of moisture loss. The optimal values of relative humidity for mature green tomatoes are within the range of 85–95% (v/v) but 90–95% (v/v) for firmer ripe fruits (Sandhya, 2010).

Table.1 Mean value of physicochemical properties of tomato fruit at different maturity stage

Treatments	Juice content (ml/kg)	Firmness kg/cm2	pH	TA%	TSS (^{o}Brix)	Shelf life In storage
MG	31.66a	3.20a	4.23a	3.98a	4.47a	Large
MR	39.16a	2.67b	4.32b	2.36b	5.13b	Medium
FR	38.66b	2.20c	4.63c	2.11c	6.57c	Small

Source: (Wisner *et al.*, 2002).

Table.1 Main effect of maturity stages on the Vitamin C, pH and titrable acidity content of tomato at different days of storage

Treatment	Vitamin C (mg/100g)			pH			Titrable acidity (%)		
DAS	0	3	6	0	3	6	0	3	6
Mature green	8.58	7.67	6.82	20.05	17.51	16.51	13.54	11.36	10.29
Half ripen	0.045	0.071	0.032	0.062	0.097	0.044	4.23	4.27	4.38
Full ripen	4.16	4.20	4.25	4.17	4.23	4.25	0.03	0002	0.001

Source: Sing (2000).

Table.2 Cumulative physiological weight loss (%) of tomato fruits at various days after storage (DAS) as affected by harvesting methods at ambient condition (24 ± 30 C and 70± 5% RH)

Harvest method	2 DAS	4 DAS	6 DAS	8 DAS	10 DAS
Without stalk	3.01	6.10	8.36	11.00	15.27
With stalk	2.97	6.04	8.28	10.45	15.07

Source: Garcia *et al.*, (2006)

Table.3 Total soluble solid content of tomato varieties stored under ambient condition

Tomato varieties	Total soluble solid					(°Brix Firmness rating scale)				
DAS	0	4	8	12	16	0	4	8	12	16
Roma VF	4.2	4.32	4.4	4.8	5.2	6.0	5.9	5.8	5.6	5.5
Marglobe	4.1	4.1	4.2	4.3	4.6	6.0	6.0	5.9	5.8	5.7
Melkashola	4.2	4.2	4.4	5.0	5.4	6.0	6.0	5.8	5.7	5 5

Source: Getinet *et al.*, 2011

Table.4 Effect of temperature on the deterioration rate of a non-chilling sensitive commodity

Temperature (°C)	Assumed Q_{10}*	Relative velocity of deterioration	Relative postharvest-life	Loss per day (%)
0	-	1	100	1
10	3	3	33	3
20	2.5	7.5	13	8
30	2	15	7	14
40	1.5	22.5	4	25

Source: Castor *et.al* (2005)

Table.5 Cumulative physiological weight loss (%) of tomato fruits at various days after storage (DAS) as affected by Cacl concentration at ambient condition (24 ± 30 C and 70± 5% RH)

Cacl2 con	2 DAS	4 DAS	6 DAS	8 DAS	10 DAS
0.25 %	3.21	6.13	8.56	12.06	17.02
0.50 %	2.89	5.33	8.56	12.06	17.02
0.75%	2.25	4.81	6.93	8.25	12.80
1.00%	2.57	5.36	6.85	8.31	12.14

Source: Garcia *et al.*, 2006)

Below the optimal range, evapotranspiration increases resulting in shrivelled fruits. Storage of tomato fruit at a lower relative humidity can result in shrivelling. Addition of moisture (wetting fruits) in lower relative humidity storage can reduce weight loss and prevent fruit from shrivelling. Meanwhile, completely saturated atmospheres of 100% relative humidity should be avoided, as moisture condensation on the fruit surfaces may encourage mould and fungal development shewfelt.1990.

Combination of gases

The combination of different gases in a storage environment is very important in extending the storage life of tomato fruits. The optimal atmosphere needed to inhibit senescence in mature green and ripe fruit of tomatoes is 3–5% (v/v) of oxygen but for carbon dioxide it is 1–3% (v/v) and 1–5% (v/v) in mature green and ripe fruit, respectively, whilst 94–96% (v/v) of nitrogen gas is required (Kader, 2003). A very low supply of oxygen can have a detrimental effect on fruits by causing anaerobic respiration. Carbon monoxide (CO) has been investigated as a gas for treating fruits and has been found to speed up ripening. It is therefore necessary to balance the carbon monoxide with low oxygen to delay senescence in the fruits (Akhtar and Hussain, 2011).

Carbon monoxide slows down postharvest pathogenic infestations whilst improving some quality traits of tomatoes. For instance, tomatoes stored in 5–10% (v/v) carbon monoxide with 4% (v/v) oxygen were found to have superior total soluble solids (TSS) and titratable acid (TA) profiles as compared to control samples stored in air (Akhtar *ET AL.*, 2011).

Calcium chloride application after harvest (post harvest)

Postharvest calcium application has a positive effect on many storage parameters of various fruits and vegetables. For instance, the use of calcium chloride in controlling rapid ageing in harvested fruits (Prakash *et al.*, 2006). Postharvest calcium chloride application reduces respiration, decreases ethylene production, and delays senescence in fresh produce such as tomatoes (Morvan and Thellier, 2004).

Exogenous application of calcium maintains cell-wall integrity and protects it from degrading enzymes, enhancing better linkages between pectic substances within the cell-wall whilst increasing the cohesion of cell-walls (Kwon, Park, and, Kang 2009). This therefore gives an indication that the rate of senescence in fruits is closely related to the amount of calcium in the plant tissue and varying the calcium status affects the rate of senescence. Altering the levels of exogenous calcium application affects parameters for senescence such as protein and chlorophyll content, respiration rates, and cell membrane also note that addition of calcium rigidifies cell-wall and obstructs enzymes such as polygalacturonase from reaching active sites

Fruits treated with CaC_2+ have shown higher values for fresh firmness during storage whereas they have quicker development of red color, greater weight loss and higher soluble solids content rather than non- treated fruits during the shelf life (Garcia *et al.*, 2006).

Physical handling

Physical handling can have a drastic effect on the postharvest quality or life of harvested fruits (Wills 2009). Rough handling during harvesting and after harvesting can result in mechanical injuries which affect quality. Typical industrial production systems associated with tomatoes may include mechanical harvesting, packing into crates, sorting, grading, washing, and transporting over long distances. At each of these stages there may be significant occurrence of mechanical injury which may be bruising, scarring, scuffing, cutting, or puncturing the fruits. In small-scale tomato production, mechanical injuries may result from the use of inappropriate harvesting containers and packaging materials miller, 2003

According to Miller 2002, the effects of mechanical injuries on fruit are cumulative. Injuries which are equivalent to or greater than the bioyield point lead to a total breakdown of the structure of the affected cells which is accompanied by unwanted metabolic activities which may include increased ethylene production, accelerated respiration rates, and ripening , which results in either reduced shelf life or poor quality. It is therefore important to handle tomato fruit with care during the harvest and postharvest activities to minimise mechanical injuries to avoid losses. understanding and managing the various roles that pre harvest factors like fertilizer cutivar selection and irrigation can play in the quality of fruits at harvest is very important in order to produce high quality fruits at harvest . tomato are highly perishable and are subjected to rapid quality loss after harvest .post harvest handling practices or factors such as optimum temperature ,right relative humidity , and right gases in storage.

Effect of damage during transport and packing on post harvest quality of tomato

Less suitable and not proper facility of tomato crop affect the post harvest life and quality of the product. Temperature requirement or refrigeration facility is required. During transportation if the product is not well located vibration of the product influence the post harvest yield of the product. Tomatoes are packaged in open and closed fruit crates (tomato crates), tubs, cartons, trays and jointed boxes. Carless packing also influences the product. The plastic container which is currently not in use in the system performed better in reducing mechanical damage resulting from vibration and impact than the traditional baskets currently being used to package fresh tomatoes and should therefore be exploited. Generally, all the above factors and contributes their own role in post-harvest loss of tomato (Sargent *et al.,* 2003).

Summary and conclusion

Tomato is one of the most important supplementary sources of minerals and vitamins in human diet and belongs to the family Solanaceae. Postharvest quality management of tomatoes starts from the field and continues until it reaches the final consumer.

The quality of any fruit after harvest cannot be improved by the use of any postharvest treatment method or handling practices but can only be maintained. Understanding and managing the various roles that preharvest factors like fertilizer application, maturity stage, cultivar selection, and irrigation can play in the quality of fruits at harvest is very important in order to produce high quality fruits at harvest.

Tomatoes are highly perishable and are subjected to rapid quality loss after harvest. Using best postharvest handling practices or factors such as optimum temperature, right relative humidity, and right gases in storage, the use of postharvest calcium chloride application and the best physical handling procedures to maintain the quality after harvest is also critical.

The quality and storage life of tomatoes after harvest depends on not only the postharvest factors alone but also some preharvest factors during production.

Recommendation

It is recommended that in order to extending shelf life and get proper quality of tomato fruit suggesting the following method is very important

Good cultural practices like irrigation, fertilizer etc…
Harvesting at proper stage
Slow down product respiration rate
Lower temperature below 41^{o}F by refrigeration
Increase the humidity in the storage room.
Reduce the risk of microbial growth.
Cleaning the product sorting grading packaging quick cooling
Good refrigerated storage
Good transportation & distribution

References

Alam T. Tanweer G, and. Goyal G. K., 2007. Packaging and storage of tomato puree and paste," Stewart Postharvest Review, vol. 3, no. 5, pp. 18,.

Arah I. K, Kumah E. K., Anku E. K, and. Amaglo H.,2015. "An overview of post-harvest losses in tomato production in Africa: causes and possible prevention strategies," Journal of Biology, Agriculture and Healthcare, vol. 5, no. 16, pp. 78–88.

Artés, F A. Gómez P., and. Artés-Hernández F.,2006."Modified atmosphere packaging of fruits and vegetables," Stewart Postharvest Review, vol. 2, no. 5, pp. 1–13.

Beckles, D. M., 2012. "Factors affecting the postharvest soluble solids and sugar content of tomato (*Solanum lycopersicum* L.) Fruit," Postharvest Biology and Technology, vol. 63, no. 1, pp. 129–140.

FAOSTAT, Global Tomato Production in 2012, FAO, Rome, Italy, 2014.

Filgueira FAR..,2012. New manual of Olericultura: Modern agro-technology in the production and commercialization of vegetables. 3th ed. Viçosa: UFV English.

Freeman B. B. and Reimers K., 2011. "Tomato consumption and health: emerging benefits," American Journal of Lifestyle Medicine, vol. 5, no. 2, pp. 182–191, 2011. . Getinet H, Seyoum, T and. Woldetsadik K, 2012."The effect of cultivar, maturity stage and storage environment on quality of tomatoes," Journal of Food Engineering, vol. 87, no. 4, pp. 467–478.

Hanna H. Y.,2009. "Influence of cultivar, growing media, and cluster pruning on greenhouse tomato yield and fruit quality," Hort Technology, vol. 19, no. 2, pp. 395-399, Hobson G. E., 2008. "Pre-and post-harvest strategies in the production of high quality tomato fruit," Applied Agricultural Research, vol. 3, no. 5, pp. 282–287.

Luengwilai K., Beckles D. M., and. Saltveit M. E, 2012. "Chilling-injury of harvested tomato (*Solanum lycopersicum* L.) Cv. Micro-Tom fruit is reduced by temperature pre-treatments," Postharvest Biology and Technology, vol. 63, no. 1, pp. 123–128,

Melkamu M. Seyoum, T, and Woldetsadik K.,2008 "Effects of pre- and post harvest treatments on changes in sugar content of tomato," African Journal of Biotechnology, vol. 7, no. 8, pp. 1139–1144.

Moneruzzaman K. M. Hossain A. B. M. S, Sani W.,. Saifuddin M, and Alenazi M., 2009. "Effect of harvesting and storage conditions on the post harvest quality of tomato," Australian Journal of Crop Science, vol. 3, no. 2, pp. 113–121.

Oke, M. Ahn T., Schofield A., and. Paliyath G,2005 "Effects of phosphorus fertilizer supplementation on processing quality and functional food ingredients in tomato," Journal of Agricultural and Food Chemistry, vol. 53, no. 5, pp. 1531–1538

Oko-Ibom G. O. and. Asiegbu J. E, 2007."Aspects of tomato fruit quality as influenced by cultivar and scheme of fertilizer application," Journal of Agriculture, Food, Environment and Extension, vol. 6, no. 1, pp. 71–81

Pranamornkith T., East A, and Heyes, J, 2012 "Influence of exogenous ethylene during refrigerated storage on storability and quality of Actinidiachinensise (cv. Hort16A)," Postharvest Biology and Technology, vol. 64, no. 1, pp. 1–8

Puiatti M, Balbino JMS, Fonseca MJO, Ronchi CP., 2010. Physiology of tomato development. In: INCAPER, editors. Tomato. Vitória: INCAPER; English.

Rehman M., Khan N., and Jan I., 2007 "Post harvest losses in tomato crop (a case study of Peshawar Valley)," Sarhad Journal of Agriculture, vol. 23, no. 4, pp. 1279–1284.

Raison J. K and. Lyons J. M, 2007. "Chilling injury: a plea for uniform terminology," Plant, Cell & Environment, vol. 9, no. 9, pp. 685–686, 2006. . Toivonen, P. M. A "Fruit maturation and ripening and their relationship to quality," Stewart Postharvest Review, vol. 3, no. 2, pp. 1–5.

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