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Post harvesting and value addition in tomato

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Abstract

Tomato production has increased in recent years due to the economic. The crop's nutritional value is significant. Numerous research improvements made across the whole value chain have enabled this increase. Scientific study, on the other hand, has primarily focused on production while ignoring postharvest difficulties. Tomato growers have thus had good harvests in recent years, yet good yields in underdeveloped nations do not translate into profit because mostly tomatoes are wasted after harvest. According to this study, the fruit's postharvest quality and shelf life will be influenced in part by some postharvest handling procedures and treatments performed after harvest. Harvesting, precooling, washing, and disinfecting, sorting and grading, packaging, storage, and shipping were all vital in preserving quality and extending shelf life. Using appropriate postharvest treatments such as refrigeration, heat treatment, modified atmosphere packaging (MAP), and the application of 1-methylcyclopropene (1-MCP) and calcium chloride (CaCl₂).

Keywords: Post-harvest, production, value addition, tomato

Introduction

Tomatoes (*Solanum lycopersicum* L.) are one of the most widely grown and consumed horticulture crops on the planet. Tomatoes are grown and processed in much of India during two seasons: kharif (August to October) and winter (December to April) (rabi). Tomatoes are also cultivated in the off-season (May to July), including under protected agriculture, when conditions allow, though costs are frequently greatest during this time due to low amounts of production. Even though the crop is said to have originated in the wild in Peru, Ecuador, and other parts of the tropical Americas, its nutritional and economic importance has led to its global production. By weight, tomatoes are only second to potatoes in terms of global production of all horticulture vegetables. Tomatoes can be eaten in a variety of ways and in a wide variety of recipes. It can be eaten fresh in salads or used in a variety of foods and drinks as an extract or sauce.

Tomatoes and tomato-based foods contain a wide range of nutrients as well as other health advantages. Tomatoes contain more lycopene, an antioxidant carotenoid that helps to prevent cancer and other cardiovascular illnesses. It is a very important part of the people's diet in locations where it is farmed and consumed. Tomatoes can be used for a variety of purposes, which may contribute to their vast production. Because of the crop's economic and nutritional value, tomato production has surged in recent years, reaching around 163 million tonnes in 2013. Improved cultivars or types that are high producing and resistant to both diseases and drought have resulted from research in the production side of the full value chain in tomato farming. This has resulted in good harvests for tomato growers in recent years; but, for many producers in underdeveloped nations, a strong yield does not convert into profit, as the majority of the crop is lost after harvest. In most underdeveloped nations, postharvest loss is a serious hindrance to tomato production. Tomatoes are a perishable crop with a limited shelf life of roughly 48 hours in tropical environments due to their high moisture content. To extend the shelf life of the crop after harvest, specialized postharvest handling practices and treatment technologies are required. Failure to follow these specialized handling and treatment methods will result in significant losses. In tropical climates, tomatoes can lose up to 50% of their value between the harvesting and consuming stages of the distribution chain. To reduce postharvest losses and increase profitability for handlers in developing nations, it is critical to understand the proper handling practices and treatment methods for harvested tomatoes. Tomato processing is a massive industry. India has been exporting tomato paste and ketchup in the form of processed tomatoes. The goal of this research is to examine certain post-harvest

techniques and processing technologies developing-country to handlers and how they can affect the postharvest quality and shelf life of produced tomatoes.

Factors Affecting the Quality and Shelf Life of Harvested Tomatoes

1. Fertilizer application
2. Pruning
3. Maturity stage
4. Cultivar type
5. Irrigation
6. Temperature
7. Relative humidity
8. Combination Gases
9. Physical Handling

Preharvest Factors Affecting the Postharvest Quality of Tomatoes

1. Fertilizer Application

Adequate supply of potassium fertilizer in tomato production improves the fruit quality and the minimized yellow shoulder in tomato. Insufficient application of potassium in soilless tomato production leads to fruit disorder in ripening stage. Inappropriate nitrogen application for greenhouse grown tomatoes decreased the fruit quality by decreasing the sugar content of the fruits. Excessive application of boron affected the quality of tomato fruits and less supply of boron reduce fruits firmness which is one of the major concerns during storage.

2. Pruning

It helps to reduce the competition between fruits as it ensures the nutrients are channeled to fewer fruits sinks which can lead to increased fruit size. Pruning helps to increase in yield and reduce cull that is unwanted parts. It should be done under right growing condition otherwise it may lead to smaller size in few fruits.

3. Maturity Stage

It is an important stage to determine the quality traits. Tomato can be harvested in different stages during maturity like mature green, half ripen, red ripen stage. Each harvesting stage has its own postharvest attribute. Harvested at green stage is the best for longer shelf life but nutritional values and appearance may be affected when harvested green stage because sugar transport will occur after maturity. For industry processing harvesting at pink stage is recommended as it contain more acidity because tomatoes are processed as high acid food.

4. Cultivar type

The quality, yield and physical or morphological characters of tomato is highly dependent on the cultivar type or varieties. Different characters exhibit different attribute in postharvest

5. Irrigation

Tomato is sensitive to water application. According to Marouelli *et al.* [23] the highest tomato water use efficiency observed 37 to 45 days after blossom. Excessive and irregular irrigation leads to the reduction in the number of fruits and fruits might get rotten easily due to excessive water. Heavy irrigation after long spell of drought causes fruit cracking. In tomatoes flowering and fruiting stage are critical stage.

Postharvest Factors Affecting Quality of Tomatoes

Postharvest technology involves grading, packaging, storage. These are very important to overall food safety and product quality. Some factors can affect the qualities of tomatoes after harvest.

1. Temperature

For storage of tomato at low temperature 20° C to delay ripening and postharvest loss. Less than this it may cause chilling injury, which is characterized by premature softening, surface pitting etc. Delaying in time of storage right after harvesting has a great impact on shelf life.

2. Relative humidity

Tomato contains very high amount water hence it doesn't shrink or dry up after harvested. The moisture holding capacity of air increased with the temperature. RH can influence water loss decay of fruit. The optimum RH of mature green tomatoes is 85-95 (v/v) and for ripped tomato 90-95 v/v.

3. Physical Handling

It plays an important role in quality and extending shelf life of tomato and handling is one of the major factors to maintain quality and insuring safety. It includes cleaning, sorting/grafting.

To maintain high degree hygiene and to meet market requirement we can clean or wash tomato by whipping or washing to remove soil particle from fruit. Sodium hypochlorite can be added in water as disinfectant agent prior to market. Sorting and grading are mainly performed for quality enhancement. It can be done manually or mechanically it is based on sized of fruits and weight of fruits according to the size, weight and color of fruits the fruits will be divided and packed accordingly.

How does the loss of tomatoes occur after harvest?

In developing countries post-harvest losses takes place majorly due to improper storage facilities. Losses in tomatoes appear due to improper harvesting, mechanical damage, poor packaging and transporting conditions. Every effort must, therefore, be made to minimize these losses.

There're several implementation proposals to alleviate this phenomenon:

Maintain the right temperature while storage (ripe: 7.2; unripe: 8.9°-10° Celsius)

As it is a climacteric, so it has high respiration rate maintain relative humidity (Rh) 85-90%.

Packaging material

Plastic crates are highly recommended for tomatoes as they provide sufficient protection from damage. Poly and mesh bags do not provide enough protection, moreover if fruit gets damaged it will rot inside it.



Fig 1: Packaging material

Post-harvest disease management

1. Gray mold: *Botrytis cinerea*
Management: hot air or hot water treatment
2. Rhizopus rot: *Rhizopus stolonifer*
Management: avoid bruising during packaging and transporting
3. Anthracnose: *Colletotrichum coccoides*, *C. gloeosporoides*, *C. dematium*
Management: Hot water treatment
4. Phoma rot: *Phoma destructiva*
Management: to control contamination during packaging- 5% borax solution containing 0.5% liquid tar soap as washing medium.
5. Fusarium rot: *Fusarium oxysporum*
Management: remove infected plants and destroy.

Value addition in tomato

Value addition is difference in total cost of acquiring asset and income received from sale of asset. Value addition is done to generate more profits moreover it is providing employment which is ultimately generating income. Currently, ketchup in market is in demand all over the world. Several small and medium sized enterprises are involved in production of its processed products. The value addition of tomatoes in various industries includes:

- Tomato ketchup
- Tomato sauce
- Tomato juice
- Tomato soup
- Tomato pulp
- Tomato paste, etc.



Fig 2: Value addition in tomato

Textile Industry

In upcoming years tomatoes can become commercially important as a natural source of carotene (red-orange colored pigment). The natural dye (carotenoids) present in tomato peels and pulp are extracted through various methods and used as natural dyes in various fabrics by researchers (wool, silk, and polyamide). The pacifying nature and brilliant shades of natural dyes makes textile materials eye catching

and attractive to customers (Adeel *et al.* 2017). The natural dyes are more environments friendly and if the waste is used in such way it can avoid environmental pollution.

Food industry

- Tomato is universally accepted as “Protective food” and No. 1 processing vegetable in the world. According to current scenario ketchup is in high demand as a processed food all over the world. Other by-products are pickles, juices, purees, and juices etc. Tomato paste is the raw material to produce tomato products.
- Tomato puree and paste are in high export demand.

Pharmaceutical industry

Tomatoes are used in various types of medicines in pharmaceutical community. It contains lycopene, which is rich source of natural and powerful antioxidant, as well contains vitamin C, beta- carotenoid, particularly flavanols and flavones known to fight inflammation and cancer. It has many benefits like:

- Good for diabetic patient as its rich in chromium.
- Reduces cholesterol levels and blood pressure which is ultimately good for heart.
- It contains coumaric acids, which protects body from carcinogenic emitted by cigarette smoke.
- Reduces the risk of various types of cancer.

Tomatoes marketing

Tomato is important solanaceous vegetable after potato cultivated in India. In the market there is high demand of it because it is considered as no. 1 canned vegetable or processing vegetable in the world. In local markets, tomatoes are bagged in plastic bags and carries by people. India has approximately 3, 50,000 hectares area under cultivation with annual production of 43, 6000 tons. 80% of production is consumed as vegetable and 20% of it is used for processing purpose. Transportation plays major role in marketing such as auto-rickshaws, trucks and mini-trucks carries tomatoes.

Value addition and marketing model

Marketing pattern plays an important role; it varies from region to region in India because of climatic conditions. In state like Punjab production of vegetables are not very common especially at commercial, its known for cereal production as farmers are more attracted towards MSP criteria on other hand Karnataka and Maharashtra are producing tomatoes for export. It is used for making ketchup, sauce, soup, puree etc.

Producers

Producers sell the produce at “Sabzi Mandi”, mostly all cities and towns have “mandi” system. Growers keep 2-3% of their production to themselves for their own consumption. In Punjab majorly the tomatoes are produced in Jalandhar, Hoshiarpur, and Amritsar; in south Nasik, Pune and Bengaluru produce export quality of tomatoes.

Wholesalers

There are different systems of selling the tomato or any other commodity, which varies according to the availabilities and resources. One of them is addition of wholesaler or middleman. In this manufacturer sell their product to wholesalers and then to retailers where products reach consumers. The wholesalers collect the product from

producers then further maintenance is done by them. It boosts the quality corporate investment decisions and facilitates the allocation of resources in the economy.

Salesman

They buy the tomato from middleman or sometimes from farmer depend on the availability then in market tomatoes are sold by shopkeepers, vegetable hawkers and in stores like easy day, more and reliance etc.

Need of Tomatoes

Universally, Tomato is accepted as “protective food”.

It's natural and rich source of lycopene.

Tomato has anti-inflammatory and anti-cancerous properties.

No. 1 processing vegetable all over world (especially used for ketchup making).

Cost and income return

It varies according to farm size (small, medium or large)

Plating material= 5500

Pesticides and herbicides= 7000

Fertilizers and manures= 8000

Irrigation= 3000

Labor charges= 20000

Marketing cost= 2000

Cost of fencing and support= 800

Total cost= 39,300

Income returns

Yield price (per kg) = 40Rs according to Jalandhar market on 30 April 2022.

Income of 3 tons (an average yield per acre) = 30,000 * 40 = 120000Rs

Profit and returns

It is calculated difference between income and cost of total i.e.

Income-cost of total

= 1,20,000- 39,300 = 80,700 Rs.

Hence, the profit is 80,700Rs.

Conclusion

Tomato can be grown in wide range of soils from sandy to heavy clay. However well drained sandy or red loam soils rich in organic matter with a PH range of 6-7 are considered as ideal. Tomato is a warm season crop. The best fruit colour and quality is obtained at a temperature range of 21^o-24^o Celsius. Yield about 96.2 tonnes per ha in a crop duration of 140-145 days. The tomato plants are semi determinate in nature about 90-95 cm long. These are also suitable for HDP. Total earning from 1 acre of tomato cultivation is about INR 1,19,850. This can be in simple words be calculated as 30K INR for straight 4 months. High phosphorous fertilizer is essential for its cultivation. After safe harvesting the crops must be processed so that they can be consumed or stored for future use. The major reasons of postharvest losses are man handling, rotting, mechanical damage, not optimal temperature, and relative humidity set, etc. Using plastic crates for transporting postharvest can reduce its loss. We must reduce the storage temperature to increase its shelf life. As we know tomato is known for its pigment named as “lycopene” and to obtain that also we do need to maintain the temperature of 21^o-24^o Celsius, if its more than 27^o Celsius then production of pigment will be dropped rapidly. Farmers

should understand the importance of value addition as if they adopt it, they can earn more profits and can remove the middleman. 20-30% loss occurs in tomato because of poor storage facilities so government needs to work on that so that losses can be prevented.

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