Effect of packing materials on storage of tomato

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Abstract

The process of fruit tomato (Lycopersicon esculentum Mill) sorting, grading and packing is wretched. Fruit firmness was tested on packing materials like wooden crates, corrugated cardboard boxes with separate cells and holes made in the boundary walls and nylon mesh bag for 12 days keeping green hard textured tomato at 20°C room temperature. Fruits placed in corrugated cardboard box showed 69.00g fresh and 11.05 g dry weight. Open container and mesh bags showed accelerated fruit decay frequency (complex infection) due to faster fungal sporulation and mycelial spread. Fruit quality seem to be linked with air circulation and hardness of the material.

Key words: Lycopersicon esculentum, post harvest, packing material, shelf life.

Introduction

Tomato (Lycopersicon esculentum Mill.) is a member of the Solanaceae family which is famous for a number of medicinal, nutritional and and horticultural crops like egg-plant, potato tubers and tomatoes. Botanically this fruit is known as berry. (Salunkhe et al., 2005). Though it is perennial crop but some of its cultivars are grown as an annual crop in various parts of the world (Nunes et al., 1996; Knaap et al., 2002). It is the second most important vegetable crop next to potato. (FAO, 1989)

Tomatoes are a popular food item in Pakistan. High in water soluble vitamins and minerals, dietary fiber, low in fat and calories, main source of vitamins A, C and lycopene, they are consumed on a daily basis in households. Tomato production is an important source of income for smallholder farmers. While domestic tomato production has intensified across the country in recent years, it still does not meet the high demand, so tomatoes are imported from neighboring countries especially India several months of the year. This situation is attributed to a number of constraints in the production and marketing chain (Agarwal and Rao, 2000).

Post-harvest loss has been defined as a “measurable quantitative and qualitative loss of a given product at any moment along the post-harvest chain” (De Lucia and Assemmato, 1994). Change in the availability, edibility, wholesomeness or quality of the food that prevents it from being consumed” (FAO, 1989). Post-harvest loss does not equal food loss necessarily. Thus, the reduction of post-harvest losses of perishables is of major importance when striving for improved food security in developing countries (Kader, 2005).

Postharvest losses are often more significant than fresh fruit and vegetables losses that occur in the field. During storage, fruit and vegetables deteriorate through the action of spoilage microorganisms, which become activated because of the changing physiological state of the fruit and vegetables. The quality of fresh tomatoes is mainly determined by appearance (colour, visual aspects), firmness, flavour and nutritive value (Giovannoni, 2001).

High quality fruits have a firm, turgid appearance, uniform and shiny color, without signs of mechanical injuries, shriveling or decay. Consumers measure the quality of tomato fruit primarily by three factors: physical appearance (color, size, shape, defects, and decay), firmness, and flavor. Fruit quality is significantly affected by stage of ripeness when removed from the plant, number of times handled, and storage temperature and time. The longer the fruit remains on the plant, the more flavorful the fruit is. Less handling reduces the incidence of bruising, and some have suggested that flavor is reduced with increased handling. It is frequently observed that tomato fruit not ripened on the plant does not have the same flavor and aroma as fruit that has developed its red color (or final fruit color) on the plant. Flavor, comprised of aroma, is an important food quality attribute. Another aspect of fruit flavor is fruit size; the smaller fruit are more flavorful as compared to larger (Thorne and Alvarez, 1982). Present studies were designed to investigate fruit
quality deterioration due to type of packing material used in routine practice of fruit shipment

Materials and Methods

Three types of packing material were taken i.e. wooden crates of mango acacia, cardboard boxes and polythene gauze sacks and brought to Seed and Post harvest lab of Institute of Plant Pathology (IPP) University of the Punjab, Lahore. There were three replicates of each packing material.

Cardboard Boxes

The 1mm thick cardboard boxes of dimensions 20x20x5 cm were manually designed from recycled corrugated cardboard sheet. The box was divided in 9 cells each of 2.2 × 2.2 cm with pipe cardboard. Small holes of 5.0 mm were made on the side walls of the box at 3.5 cm (Fig 1).

Wooden boxes:

The wooden crates with capacity of 5kg commodity were obtained from the vegetable market (Fig. 2).

Polythene gauze sacks:

Small-sized sacks, designed for the experimentation purpose, were obtained from the local vegetable market.

Experimental Setup:

All the packing materials were properly arranged in replicates in prevailing normal storage conditions for 15 days.

Results and discussions

There is significant increase of post-harvest losses in the markets depending upon the business volume and chain as reported by De Lucia and Assennato, (1994). Business volume significantly influences the post-harvest losses (De Lucia and Assennato, 1994). Economic losses calculated on farm market distance gradients of 50, 100, 200, 400, 800 and +800 km ranged. Loss figure is higher in the distance gradient +800Km and ranged 19-27 %, while the loss ranged 7-9 % where farm market distance is less than 50 km.

People of Pakistan prefer fresh fruits and vegetable over tin food and this trend is increasing globally last decade. Fresh vegetable imports to USA increased by over 250%, while fresh fruit imports increased by 155% (Clemens, 2004). The suitability of effective protective material prolongs the shelf-life and quality of perishable crops like tomato. In Pakistan tomato shipment is made in conventional wooden crates made up of mango or acacia wood or some time in the wooden knitted baskets. These crates are of rectangle shape available in 5, 8 and 10 kg fruit capacity. The process of fruit sorting, grading and packing is wretched. Unhygienic environment and mishandling during post harvest is routine practice of the market (Plate 1).

Import of tomato from China and India is seeding concepts for exercise of new packing trends. In the present studies, up to 30% shipment losses have been reported due to selection of improper packing material and physical damage to the produce. Packing material and cushion material are responsible for fruit decay. Extended shelf-life can be obtained by wrapping single pieces or by collective packing in inert atmosphere or mixture of gasses using appropriate combination of packaging materials (Personal communications with market functionaries and representatives of Agricultural Marketing Department, Punjab). Permeability control of certain combinations of packaging materials for the packing of fresh vegetables is necessary to obtain favourable barrier characteristics (Vursavus and Ozguven, 2004).

Ethylene and CO₂ production influence the qualitative nature of colour, flavour volatiles, sugars, and organic acids in tomato, which determines whole concept of fruit quality. In the process of fruit ripening to decay changes occur in the pattern of climacteric ethylene production. Eugenol decreases during ripening (cis-3-hexenol, acetaldehyde, cis-3-hexenal, trans-2-hexenal, hexenal acetone, 6-methyl-5-hepten-2-one, geranylacetone, and 2-isobutylthiazole) increased in concentration, peaking in the turning, pink, or red stage of maturity, all flavour components except ethanol and hexanal in the red stage (Baldwin et al., 1991, Buttery et al., 1987, Buttery et al., 1988).

Vibration in the process of shipment leaves multifarious impact on nutritional, consumer choice and economic value of the crop. Corrugated cardboard box provides optimal environment to the fruit because of soft cushion and temperature/transportation vibration resistant material showed highest shelf life of 10 days without mechanical injury to fruit. Low cost and advantage of uninhibited air flow is recommended for fruit shipment. Climatic interaction of transport vehicle and type of packing plays a major role in determining post harvest plays till it reaches to final destination (Table 1).
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No significant influence on dry weight of tomato fruit treated with different concentrations of edible oils. *Sesamum indicum* (10%) treatment exhibited highest value (9.7) as compared to other treatments. However, all the oils showed better performance than control with 8.8g dry weight. Tomato naturally produces lycopene which contains phenol contents and improves quality and life of oils if added (Montesano et al., 2006.) Treatment with Oil of *Sesamum indicum* revealed relatively better impact on dry weight of the fruit and rate of deterioration remained slow in this treatment (Table 2).

Weight loss, decay and rapid deterioration are often major factors that determine the storage and marketability duration of fruit and vegetables. These factors depend among others on fruit quality and physiological stage and the atmosphere surrounding the fruit. Tomato fruit kept within sealed packages resulted in an atmosphere with high carbon dioxide and low oxygen content. These conditions retained flesh firmness, low acidity and soluble solids concentration and delayed fruit lycopene development (Ait-Oubahou and Dilley 1990).

In the present studies shelf life and fruit quality seem to be linked with air circulation and hardness of the material. Fruit firmness was tested on packing material like wooden crate, corrugated card board box with separate cells and holes made in the boundary walls and nylon mesh bag for twelve days keeping green hard textured tomato at 20°C room temperature. Fruits placed in corrugated card board box showed 69.00g fresh and 11.05 g dry weight. Aeration factor was dominant in nylon mesh bags but hardness of the thread imposed negative effect on quality justifying parameters. Open container and mesh bags showed accelerated fruit decay frequency (complex infection) due to faster fungal sporulation and mycelial spread (Plate 2).

The present studies suggest the redesigning of paper material which should be shock proof, non insulator and appropriated aeration. Though no significant difference was observed among Corrugated Card board box, wooden crate and Mesh bag but wooden crate was experienced better than rest of two because least physical damage was noticed in this case. The physical damage observed in wooden crates was due to improper fixing of wooden pieces with iron nails. The open container irrespective of the nature of packing material is harmful.

![Fig. 1: Dimensions of corrugated card board box.](image1)

![Fig. 2: Dimensions of wooden crate.](image2)
Table 1: Impact of packing material on fruit freshness at room temperature.

<table>
<thead>
<tr>
<th>Treatments</th>
<th>Fresh weight (g)</th>
<th>Dry weight (g)</th>
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<tbody>
<tr>
<td>Control</td>
<td>60.99</td>
<td>8.75</td>
</tr>
<tr>
<td>Corrugated Card board box</td>
<td>69</td>
<td>11.05</td>
</tr>
<tr>
<td>Wooden crate</td>
<td>60.87</td>
<td>9.09</td>
</tr>
<tr>
<td>Mesh bag</td>
<td>60.84</td>
<td>8.98</td>
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</tbody>
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Plate 1: (A-D). Unhygienic conditions in the vegetable market responsible for early fruit decay.
Plate 2: Fungal infection complex on fruit placed in open container.

References