Mycopath (2010) 8(2)**:** 85-89

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 card board boxes with separate cells and holes made in the boundary walls and nylon mesh bag for 12 days keeping green hard textured tomato at 20^0C room temperature. Fruits placed in corrugated card board 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 fibber, 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 Assennato, 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 a*cacia*, card board 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.

Card board Boxes

The 1mm thick card board boxes of dimensions 20x20x5 cm were manually designed from recycled corrugated card board sheet. The box was divided in 9 cells each of 2.2 × 2.2 cm with pipe card board. Small holes of 5.0 mm were made on the side walls of the board 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 CO_2 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 card board 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 losses till it reaches to final destination (Table 1).

No significant influence on dry weight of tomato fruit treated with different concentrations of edible oils. *Sesamun 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 *Sesamun 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 20^0C 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.

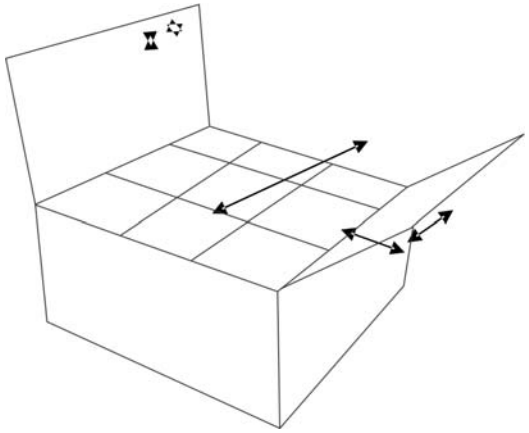

Fig. 1: Dimensions of corrugated card board box.

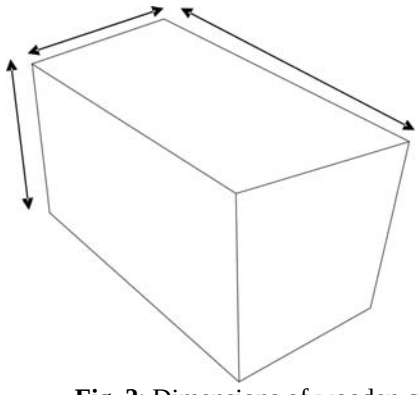

Fig. 2: Dimensions of wooden crate.

Table 1: Impact of packing material on fruit freshness at room temperature.

Treatments	Fresh weight (g)	Dry weight (g)
Control	60.99	8.75
Corrugated Card board box	69	11.05
Wooden crate	60.87	9.09
Mesh bag	60.84	8.98

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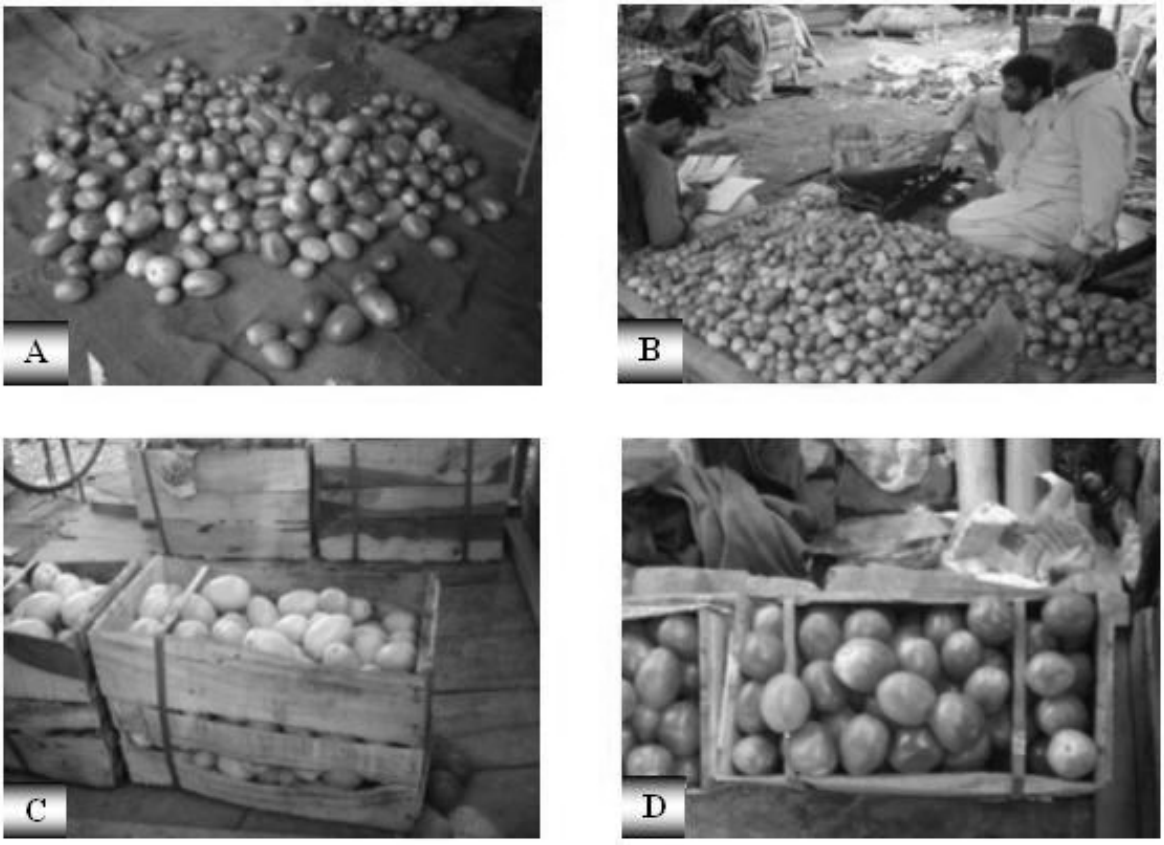

Plate. 1: (A-D). Unhygienic conditions in the vegetable market responsible for early fruit decay.

Plate 2: Fungal infection complex on fruit placed in open container.

References

Agarwal S, Venketeshwer Rao A, 2000. Tomato lycopene and its role in human health and chronic diseases. *CMAJ*., **163**: 739-44

Ait-Oubahou A, Dilley DR, 1990 Design and optimization of modified atmosphere packaging of Empire apple fruit following Controlled Atmosphere Storage. Proceeding of the Congress of the Mediterranean Phytopathologicla Union, October 28-Nov. 3, Agadir, Morocco.

Baldwin EA, Nisperos-Carriedo MO, Moshonas MG (1991) Quantitative analysis of flavor and other volatiles and for certain constituents of two tomato cultivars during ripening. *J. Am. Soc. Hort. Sci.,* **116**: 265-269

Buttery RG, Teranishi R, Ling LC, Flath RA, Stern DJ, (1988). Quantitative studies on origins of fresh tomato aroma volatiles. *J. Agric. Food Chem.,* **36**: 1247-1250

Buttery RG, Teranishi R, Ling LC, 1987. Fresh tomato aroma volatiles: a quantitative study. *J. Agric. Food Chem.,* **35**: 540-544.

Clemens R, 2004. The expanding U.S. market for fresh produce, review paper. Center forAgriculture and Rural Development. Available at http://www.agmrc.org/markets /info/expandingusmarketproduce.

De Lucia M, Assennato D, 1994. Agricultural engineering in development. Post-harvest operations and management of foodgrains. FAO Agricultural Service Bulletin No. 93.

Evan der Knaap ZB, Lippman SD, Tanksley, 2002. Extremely elongated tomato fruit controlled by four quantitative trait loci with epistatic interactions. *J. Theor. Appl. Genet.,* **104**: 241–247

FAO, 1989. Document Repository, Prevention of post-harvest food losses: Fruits, vegetables and root crops: *Atraining manual, Forest Finance Working Paper* 17-2

Giovannoni J, 2001. Molecular biology of fruit maturation and ripening. Ann. Rev. *Plant Physiol. and Plant Mol. Biol.,* **52**: 725–749

Kader AA, Morris LL, 1975. Ameloration of chilling injury symptoms on tomato fruits. *J. Amer. Soc. Hort. Sci*., **10**: 324

Kohli RK, Batish DR, Singh HP, 1998. Allelopathy and its implications in agroecosystems. *J. Crop. Prod.,* **1**:169–202

Montesano D, Cossignani L, D'arco G, Simonetti MS, Damiani P, 2006. Pure lycopene from tomato preserves extra virgin olive oil from natural oxidative events during storage *J. Amer. Oil Chem. Soc*., **83:** 933-941

Nunes MCN, Morais AMMB, Brecht JK, Sargent SA, 1996. Quality of pink tomatoes after storage under controlled atmosphere at chilling and nonchilling temperatures. *J. Food Qual.,* **19**: 363-374

Riaz T, Khan SN, Javaid A, (2010). Management of *Fusarium* corm rot of gladiolus *grandiflorus* sect. Blandus cv. Aarti) by using leaves of allelopathic plants. *Afr. J. Biotechnol.,* **9(30)**:4681-4686

Rice EL, 1984. Allelopathy, 2nd ed. Academic Press, Orlando, FL, p. 422

Salunkhe DK, Jadhav SJ, Yu MH, 2005. Quality and nutritional composition of tomato fruit as influenced by certain biochemical and physiological changes. *J. Plant Foods for Human Nutrition (Formerly Qualitas Plantarum)* **24**:85-113

Singh HP, Kohli, RK, Batish, DR, 2001. Allelopathy in agroecosystems: an Overview. *J. Crop Prod*., **4**: 1-41

Thorne S, Alvarez JSS, 1982. The effect of irregular storage temperature on firmness and surface color in tomatoes. *J. Sci. Food Agric.,* **33**: 671-676

Vursavus K, Ozguven F, 2004. Determining the effects of vibration and packaging method on mechanical damage in golden delicious apples. *Turkish J. Agric*., **28**: 311-20