

*Short communication***Effect of different packages on quality and extension of shelf-life in tomato (*Lycopersicon esculentum* L. Mill.)****S. Bhuvaneswari*¹, T.H. Singh² and A.T. Sadhashiva²**¹Division of Post Harvest Technology & Agricultural Engineering, ICAR-IIHR, Bengaluru - 560 089, Karnataka, India*E-mail: bhuvana@iihr.res.in, bhuvana@icar.org.in**ABSTRACT**

Tomato hybrid NS-2535 at the turning stage was packed in three different packages, namely, Corrugated Fibre Board (CFB) boxes of size 400 x 300 x 150mm, plastic crates (400 x 300 x 150mm) and polyethylene bag of size 300 x 450mm. Samples were stored at ambient conditions (Temperature: 28-30°C, RH: 55-62%). The samples were analyzed for weight loss (%), spoilage (%), biochemical qualities and shelf-life during storage. Fruits had a shelf-life of 11 days in all the packages. At the end of the storage period, tomato packed in CFB boxes and plastic crates showed less spoilage (8.7%-7.65%) and lower weight loss (5.02-5.48%). Biochemical analysis showed that lycopene (2.282 and 2.414 mg/100g, respectively), carotenoids (6.46 and 5.26 mg/100g, respectively) and ascorbic acid content (28.83 and 31.14mg/100g, respectively) were higher in tomato packed in CFB boxes and plastic crates compared to those packed in polyethylene bag. Samples packed in CFB boxes had a higher content of total sugars (2.54%) than those in other packages. From our studies it was found that storage life of tomato (hyb. NS-2535) packed in CFB boxes and plastic crates could be extended upto 11 days at ambient conditions, with less spoilage, lower weight loss and greater retention of ascorbic acid, lycopene and total sugar content.

Key words: Packaging, post-harvest loss, tomato, CFB box, plastic crate, polythene bag

INTRODUCTION

Tomato (*Lycopersicon esculentum* L. Mill.) is the most popular and widely grown vegetable crop. Tomatoes are highly perishable and are subject to bruising damage and spoilage during handling, transportation and storage, which account for 19% loss (Gajanana *et al*, 2006).

Packaging plays an important role in protecting and extending shelf-life of fruits. Extending shelf-life of tomatoes is very important for domestic and export marketing. Use of a wooden box (390 x 280 x 200mm) called '*peti*' for storage has been the normal practice for tomato packaging lately. These boxes weigh about 1.5kg each and have a capacity of holding 13–14kg of tomatoes. Tomatoes of relatively uniform colour and size are conventionally selected and packaged in layers in a wooden box. Dry grass is placed at the bottom,

and between layers, to provide cushioning and protection for the tomato. A sheet of newspaper is placed on top, and the box is closed by nailing (Sharan and Rawale, 2016). Manufacture of these wooden boxes has led to felling of trees, causing deforestation. Hence, there is a need to find alternative methods for tomato packaging. Corrugated fibre-board boxes (CFB), plastic crates and polythene film packages are currently widely used packaging materials. The present study was conducted with an objective to standardize suitable packaging material for extension of shelf-life in tomato.

MATERIAL AND METHODS

Packaging studies were conducted by packing tomato hybrid NS-2535 at the turning stage of maturity in three different packages, namely, Corrugated Fibre Board (CFB) boxes of size 400 x 300 x 150mm, plastic

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crates (400x300x150mm) and polyethylene bag of size 300 x 450mm (thickness 25 micron) of 5kg capacity each. The samples were stored at ambient conditions (Temperature: 28-30°C, RH: 55-62%). The samples were analyzed for weight loss (%) and spoilage (%) during storage. Physiological loss in weight (PLW) was estimated by taking the initial and the final weight of the fruit, using an electronic balance with an accuracy of ± 0.1 g, and expressed as percentage.

$$\text{PLW (\%)} = \frac{\text{Initial weight (g)} - \text{Final weight (g)}}{\text{Initial weight (g)}} \times 100$$

Spoilage of fruits was determined by visual observation. Shelf-life of the fruit was calculated as the number of days the fruit remained fresh, without any shrinkage or spoilage.

Quality parameters such as titrable acidity, ascorbic acid content, lycopene, carotenoids, reducing sugars and total sugar content, were determined using standard procedures (Ranganna, 2000)

For determining titrable acidity, tomato juice was extracted from the sample and filtered using a filter paper. Clear juice was used for analysis of titrable acidity as per Ranganna (2000). Titrable acidity (expressed as per cent citric acid), was determined by titrating 10ml of tomato juice with 0.1N NaOH. For calculating ascorbic acid content, 10g of the sample was blended with 3% HPO₃, and made up to 100ml with HPO₃. Then, it was filtered and centrifuged. An aliquot (10ml) of HPO₃ extract of the sample was taken and titrated with the standard dye against 2,6-dichlorophenol-indophenol dye of known strength to a pink end-point, persisting for 15 seconds (Ranganna, 2000). Lycopene was estimated by the 'rapid' method. Lycopene was extracted in petroleum ether and absorbance measured using a spectrophotometer at 503 nm wavelength, using a UV - VIS spectrophotometer; carotenoid content were determined as per Ranganna (2000).

All the experiments were replicated thrice and statistically analyzed using Completely Randomised Design (CRD) with WASP 2.0 software (Bhuvaneshwari *et al*, 2016)

RESULTS AND DISCUSSION

The end of storage period was determined as a time when the ripe fruit lost its freshness, showed

shrinkage of outer skin, and, spoilage. At the end of the storage period, tomato packaged in CFB boxes and plastic crates showed less spoilage (8.7% and 7.65%, respectively) compared to those packed in polythene bag (10.92%) (Table 1). Similar results were obtained by Ramkumar *et al* (1995) who reported a reduction in damage in grapes packaged in CFB box.

Table 1. Effect of various packages on quality in tomato

Type of package	PLW (%)	Spoilage (%)	Storage life (days)
CFB box	6.02	8.70	11
Plastic crate	5.48	7.65	11
Polyethylene bag	1.33	10.92	11
CD (5%)	1.01	0.92	NS

NS=Non-significant

Weight of tomato fruit decreased from the initial 'turning stage' to red-ripe stage at 11 days under ambient conditions. Weight loss was lower in tomatoes packed in polyethylene bag (1.33%), compared to those packed in CFB boxes (6.02%) or plastic crates (5.48%) (Table.1). Our results further indicated that tomatoes wrapped in polyethylene bags retained significant moisture content during storage. Similar observations were made by Shahnawaz *et al* (2012) where weight-loss in tomato fruits in the Control decreased from green-unripe to red-ripe stage at 11 days at ambient temperature. Spoilage (%) of fruits in polyethylene bags was higher (10.95%) than in CFB boxes (8.70%) or plastic crates (7.65%). This may be due to greater moisture accumulation in the polythene bag, resulting in greater spoilage of tomato fruit as compared to than in the other packages.

From Table 2, it is evident observed that at the end of the storage period of 11 days under ambient conditions, samples packaged in plastic crate had lower titrable acidity compared to that in other packages. These findings are similar to Aneesh *et al* (2007) who reported that titrable acidity gradually decreased during ripening and storage of tomatoes. Retention of ascorbic acid was higher in samples packaged in plastic crates and corrugated fibre board boxes compared to those packaged in polythene bags. Tomato fruits kept in sealed packages resulted in an atmosphere with higher carbon dioxide and lower oxygen content. These conditions may have helped retain flesh firmness, low

Table 2. Effect of various packages on biochemical quality in tomato

Treatment	Acidity (%)	Ascorbic acid (mg/100g)	Lycopene (mg/100g)	Carotenoids (mg/100g)	Reducing sugars (%)	Total sugars (%)
CFB box	0.27	28.83	2.282	6.46	1.27	2.54
Plastic crate	0.22	31.14	2.414	5.26	1.19	2.38
Polyethylene bag	0.26	25.30	1.892	4.08	1.22	2.44
CD (5%)	0.02	10.04	5.49	0.05	0.09	0.19

acidity and soluble solids concentration, and delayed lycopene development in the fruit (Ait-Oubahou and Dilley, 1990). These results are also in conformity with findings of Mathooko and Nabawancuka (2003) where increase in ascorbic acid was observed with ripening in tomato. Lycopene (2.282 and 2.414 mg/100g respectively) and carotenoids (6.46 and 5.26 mg/100g respectively) content were higher in tomato packed in CFB boxes and plastic crates compared to those packed in polyethylene pouches. Tomato fruits showed significant increase in lycopene content during storage. Chlorophyll degradation and increased lycopene synthesis results in the characteristic colour development during ripening in tomato (Yadav *et al*, 2016). Total sugar content increased during storage in tomatoes in all the packages used. These observations are similar to those reported by Sood *et al* (2011), where total sugar content increased from the 3rd day of storage to the 12th day of storage under ambient conditions. Tomatoes packed in CFB box recorded higher total sugar content (2.54%) compared to that in the other two types of packages.

From the present study, it is found that storage life in tomato (hybrid NS-2535) packed in CFB boxes and plastic crates can be extended up to 11 days at ambient conditions (average temperature: 28°C-30°C, RH: 55-62%) with lower spoilage, lower weight-loss and greater retention of ascorbic acid, lycopene and content of total sugar.

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