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Full Length Research Paper

Quality characteristics of tomatoes (lycopersicon esculentum) stored in various wrapping materials

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Being a climacteric and perishable vegetable, tomatoes have a very short life span; therefore, the present study, was conducted to determine the effect of wrapping materials on weight loss, firmness, appearance/ colour, titratable acidity, TSS and vitamin C contents during storage at ambient temperature (32±2°C). Freshly harvested mature green tomatoes were packed in polyethylene bags, newspapers and grease free papers and control (without wrapping). The fruits were then evaluated for changes in quality parameters within the different stages of ripening. The results showed that within wrapping materials, the treated fruits remained better than that of control and all the treatments are significantly different (P < 0.05) from each other. It was also observed that treated fruits showed lower weight loss, firmness and titratable acidity while, total soluble solids (TSS), vitamin C content and colour were higher in treated fruits when compared with control at the red ripe stage. It was concluded that tomatoes wrapped in polyethylene bags were better in quality with longer shelf life i.e. 28 days than other wrapping materials and control at ambient temperature.

Keywords: Tomatoes, wrapping material, physico-chemical quality, ripening, storage period.

INTRODUCTION

Tomato (Lycopersiconesculentum) is a climacteric fruit, having respiratory peak during their ripening process. Being a climacteric and perishable vegetable, tomatoes have a very short life span usually 2-3 weeks. It is one of the most popular vegetable grown in Pakistan and is widely used in salad as well as for culinary purposes. Red ripe tomatoes are used as flavoring agent in the preparation of various home made food dishes to increase the palatability. Tomato is usually used for the manufacturing of various byproducts such as tomato ketchups, sauces, purees, jellies, soups and pastes. It contains a significant amount of vitamin A and C.

High quality tomatoes have a firm, uniform and shiny color, good appearance, without signs of mechanical injuries, shriveling and bruise. The major causes of post harvest losses are decay of fruit, external injury during harvesting, handling and storage of tomato fruits. In addition, environmental factors such as soil type, temperature, frost and rainy weather during harvest can cause severe effect on storage life and quality of tomatoes (Bachmann and Earles, 2000). Temperature plays a key role in the metabolism of fruits and vegetables (Marangoniet al., 1996). Number of chemical and physical processes takes place in vegetables during shelf storage. Water comprises 90% of the fresh weight of tomato fruit and the size of the fruit is influenced by the availability of water to the plant. The large amount of water also makes the fruit perishable. Citric acid is the main acid in tomato juice and the pH of fruit is normally 4.0 to 4.5. The pH of the fruit increases throughout development (Padmini, 2006). Also, quality of most fruits and vegetables is affected by water loss during storage, which depends on the temperature and relative humidity conditions (Perez et al., 2003).

The rapid quality loss at relatively short period of 4-7 days is an efficient means of storing the fruits to reduce post harvest losses and improve the quality and acceptability in the consumer market (Thompson et al., 1998). This needs to develop technology for extending

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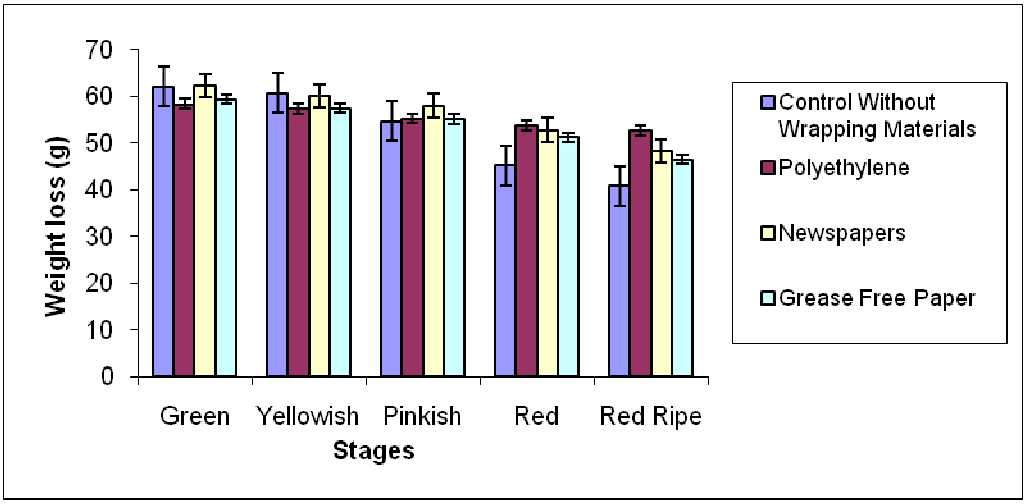

Figure 1. Effect of wrapping material and storage period on weight loss (g) of tomatoes at ambient temperature

the storage life from the point of production to the point of consumption. Packaging can markedly extend the storage life of many fresh fruits and vegetables through the inhibition of physiological deterioration and reducing weight loss (Shettyet al., 1989 and Risseet al., 1985).

Packaging can create modified gas atmospheres around the product which slows down the respiratory activity of tomato. Sealing of tomatoes in polyethylene film packages extended the length of time until ripening (Hobson, 1982). Weight loss in wrapped tomato was significantly decreased and fruits were more firm than non wrapped tomatoes (Shettyet al., 1989 and Risseet al., 1985). It had been found that the best storage temperature for delaying ripening of tomatoes fruits is 12.7°C (Parsonset al., 1994). Previous work by the investigator (Al-Mughrabi, 1989) proved that storage at 25°C was preferable for good red color of tomato fruits. Keeping in view the above facts the present study was designed to evaluate the effect of wrapping materials on the quality characteristics of tomatoes during ripening at different temperatures.

MATERIALS AND METHODS

Experimental procedure

The study was conducted to determine the effect of wrapping material on the quality characteristics of tomatoes during ripening at ambient temperature. Fresh mature unripe tomatoes were collected from the field near Kunar Plant Kissano Mori, Tandojam. Tomatoes were brought to the laboratory of the Institute of Food Sciences and Technology, Sindh Agriculture University Tandojam. Initially, green tomatoes were cleaned, washed, dried and wrapped in various wrapping material i.e. Polyethylene bags, News paper, Grease free paper and control (without any wrapping material) and was stored at ambient temperature (32±2°C).

Physical parameters such as weight loss, appearance and firmness, whereas, chemical compositions such as TSS (°Brix), pH, Titratable Acidity and Vitamin C content were determined according to the methods as described by AOAC (2000).

The data obtained was analyzed by analysis of variance according to the method as described by Gomez and Gomez (1984).

RESULTS AND DISCUSSION

The results of weight loss of tomatoes fruit (Figure 1) indicated that weight loss of tomatoes fruits in control decreased from 62.10g at initial stage (0 day green unripe) to 40.80g (red ripe stage) after 11 days at ambient temperature. Whereas, tomatoes wrapped in polyethylene bags showed minimum weight loss from 58.33 g at initial stage to 52.69 g after 28 days. The weight of tomatoes packed in news paper and grease free papers were decreased up to 48.30 and 46.50 after 28 days of storage at ambient temperature. These findings are in agreement with the results of Nei et al., (2005), De Castro et al. (2006), Aneesh et al., (2007) and Shehla and Masud (2007), they reported that weight of fruit is decreased with the passage of time towards ripening. The control not only displayed rapid increase in weight loss showing highest weight loss percentage at the end of storage period when compared with all other treatments at that stage. This is due to the uncontrolled ripening in control fruits as ripening in tomatoes is climacteric which showed a sudden increase in ethylene production and respiration rate (Stotz, 2006). The weight

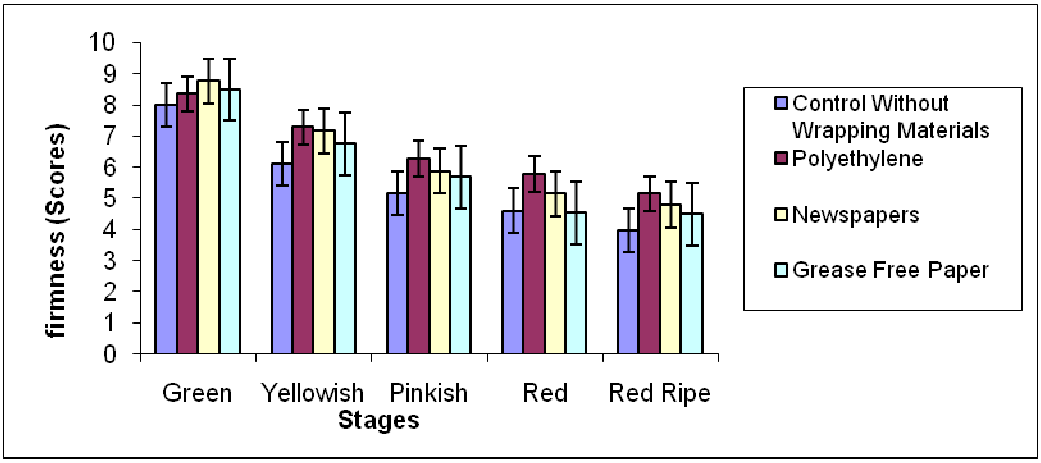

Figure 2. Effect of wrapping material and storage period on firmness (score) of tomatoes at ambient temperature

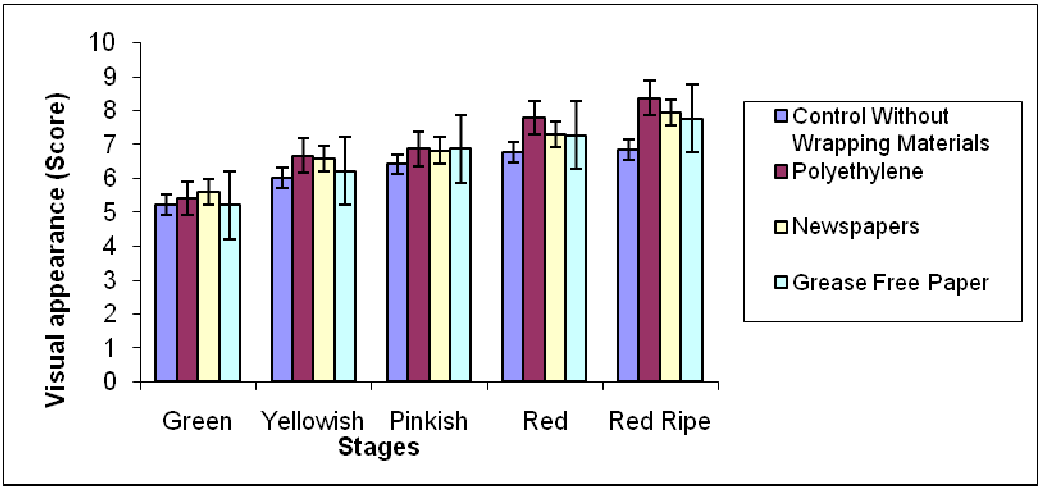

Figure 3. Effect of wrapping material and storage period on appearance/color (score) of tomatoes at ambient temperature

loss of fresh tomatoes is primarily due to transpiration and respiration. Transpiration is a mechanism in which water is lost due to differences in vapour pressure of water in the atmosphere and the transpiring surface (Bhowmik and Pan, 1992).The results further indicated that tomatoes wrapped in polyethylene bags retained significant moisture content during storage. These results are in line with the findings of Batu and Thompson (1998) that sealed pack tomatoes showed less weight loss after 60 days of storage since the water accumulated in packs created a high humid environment retarding transpiration and water loss (Thompson, 1994).

The firmness score of tomatoes fruits decreased from 8.0 (0 day at green unripe) to 3.98 (red ripe stage) after 11 days at red ripe stage in control fruit. Whereas, the tomatoes wrapped in polyethylene bags showed highest firmness score of 5.15, followed by 4.79 and 4.49 in news paper and grease free paper, respectively after 28 days at ambient temperature. The results were highly significant amongst the treatments (Figure 2). Similar results were observed by Aneesh et al. (2007) that different temperatures and wrapping material are effective in the ripening of tomatoes resultantly decreasing the firmness score.

The appearance/color scores of control tomatoes fruits increased from 5.2 at initial stage (green unripe) to 6.84 at red ripe stage after 11 days at ambient temperature. The highest color score (8.35) was obtained by tomatoes packed in polyethylene bags (Figure 3). Moreover, the other treatments like news papers and grease free paper also showed increase in scores from 5.6 to 7.92 and 5.2 to 7.75 after 28 days storage, respectively. As the ripening proceeded, the colour of fruits changed from green to pink and pink to red. At this stage, the chlorophyll pigment starts to deteriorate and beta caro-tein production was initialized (Chiesaet al., 1998). When

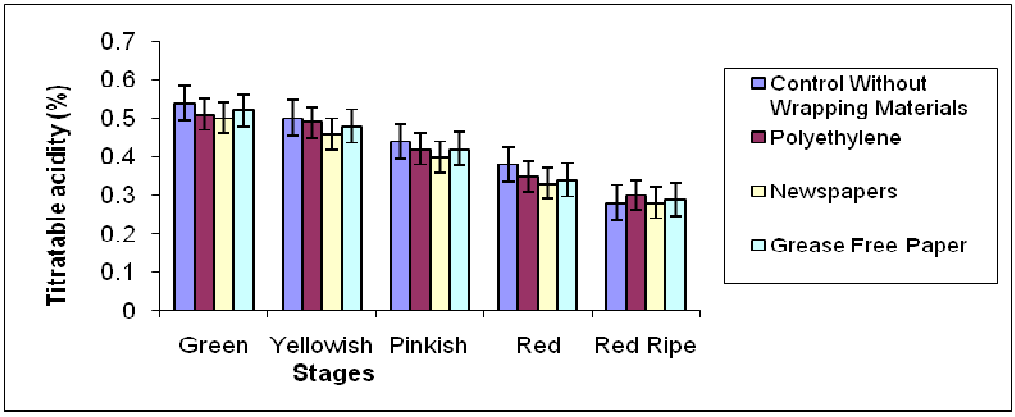

Figure 4. Effect of wrapping material and storage period on Titratable acidity (%) of tomatoes at ambient temperature

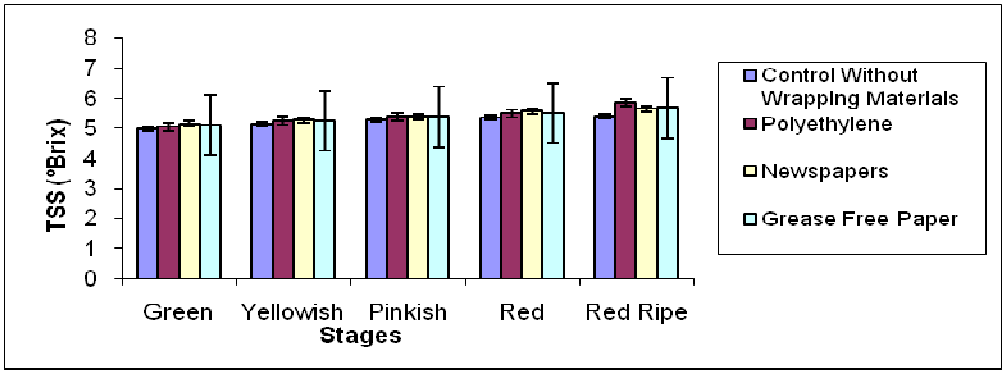

Figure 5. Effect of wrapping material and storage period on Total soluble solids (°Brix) of tomatoes at ambient temperature

stage advances from pink to pink-red the lycopene production has started producing red colour and masking the yellow colour of beta carotein (Salunkheand Desai, 1984). This change was due to the action of treatments on the fruits as polyethylene packaging helps the colour retention as described by Badshah et al., (1997).

The data of total soluble solids of tomatoes fruits presented in Figure 4 showed that total soluble solids of tomatoes fruits increased from 5.0 at initial stage (green unripe) to 5.40°brix at red ripe stage at ambient temperature after 11 days in control. However, the tomatoes packed in different wrapping materials showed slightly increasing trend towards ripening during storage. Moreover tomatoes in polyethylene bags showed 5.85 °brix after 28 days at ambient temperature. These results are in agreement with Park et al. (2004); Jeong et al., (2005) and Nei et al., (2005), they reported that total soluble solids of tomatoes increased at different temperatures and packaging materials. The total soluble solids acts as a rough index of the amount of sugars present in fruits. It is the amount of sugar and soluble minerals present in fruits and vegetables. Sugars constitute 80 to 85% of soluble solids. The total soluble solids increased during the ripening due to degradation of polysaccharides to simple sugars thereby causing a rise in TSS (Naiket al., 1993).The findings of present study are also in conformity with Shehla and Masud (2007) and Abdullah et al. (2004) who also reported that total soluble solids of tomatoes increased at different stages, temperatures and packaging materials. The significantly lower TSS contents in treated fruits were the result of delayed ripening by the action of packaging has been reported by Clarke et al. (1997), this change in TSS content was due to the natural phenomenon occurred during ripening and are correlated with hydrolytic changes in starch concentration during post harvest period. In tomatoes, conversion of starch to sugar is an important index of ripening (Kays, 1997).

The results of titratable acidity indicated that the acidity in control tomatoes increased from 0.54 at initial stage (0 day green unripe) to 0.28 % at red ripe stage after 11 days. Whereas, the tomatoes wrapped in polyethylene showed highest titratable acidity i.e. 0.30% after 28 days of storage at ambient temperature (Figure 5). However, the tomatoes packed in newspaper and grease free paper showed 0.28 and 0.29% titratable

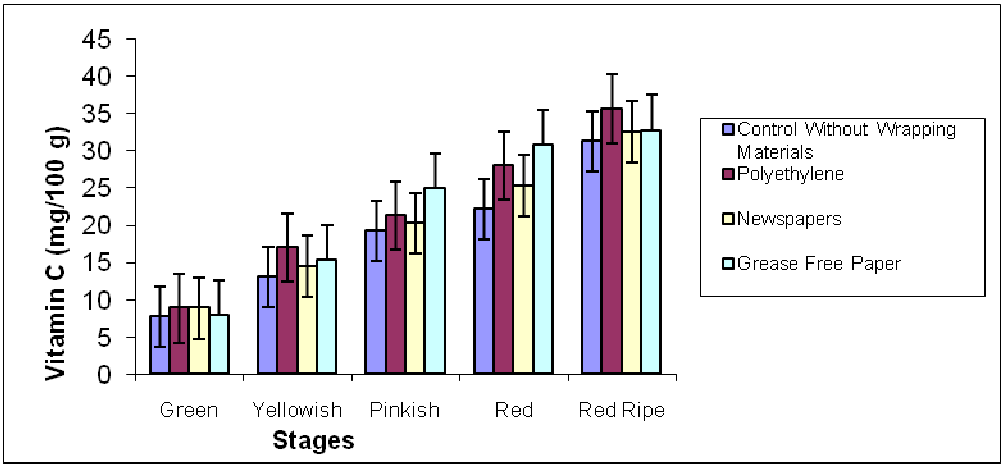

Figure 6. Effect of wrapping material and storage period on vitamin C content (mg/100 g) of tomatoes at ambient temperature

acidity at red ripe stage after 28 days at ambient temperature. Similar results were obtained by Aneesh et al. (2007) and Shehla and Masud (2007) who reported that tritatable acidity gradually decreased during ripening and storage of tomatoes. These results are also supported by Bhattacharya (2004) who stated that acidity is an indicator of maturity, ripening results in decreased acidity in fruit. It has been observed during ripening in tomatoes that malic acid disappears first then citric acid that results in reduction of titratable acidity, suggesting the catabolism of citrate, whereas, Mattoo et al., (1975) and Salunkhe and Desai. (1984) reported that ripening results in increased sugar of tomato fruit. However, during ripening yellow color appears that results in decrease in acidity. This further confirms that absence of malic and citric acid may be the main factor responsible for decrease in titratable acidity during storage. Titratable acidity gives the total or potential acidity, rather than indicating the number of free protons in any particular sample. It is a measure of all aggregate acids and sum of all volatile and fixed acids (Naik et al., 1993).

The results of vitamin C (mg/100 g) of tomato fruit (Figure 6) revealed that vitamin C of tomato fruits increased from 7.65 at green unripe stage to 31.29 mg/100g at red ripe stage after 11 days in control. However, highest vitamin C 35.60 mg/100g was recorded in tomatoes wrapped in polyethylene bags after 28 days followed by 32.70 and 32.52mg/100g in tomatoes wrapped in grease free paper and newspaper at ambient temperature. This suggested that vitamin C increases with the ripening of tomatoes. The results are in conformity with the findings of Mathooko and Nabawancuka (2003), Nei et al., (2005), De Castro et al. (2006) and Aneesh et al. (2007) that vitamin C increases with the ripening process of tomatoes. Preservation of ascorbic acid content during storage is a difficult task since it undergoes oxidation. The presence of higher O_2 concentrations in the storage atmosphere hastens this process. However in the present investigation, the vitamin C content of fruits was significantly influenced by various wrapping materials during storage.

The study concluded that polyethylene bag is comparatively better packaging material to retain good quality attributes in tomatoes during storage. Moreover, tomatoes wrapped in polyethylene bags have better quality in terms of weight loss, color and vitamin C content at red ripe stage.

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