Plant Sci. Arc. 2(1), 21-29, 2019
Publication date: February 24, 2019
http://dx.doi.org/10.33680/plsa.2019.010
ISSN 2518-6965 (Online)
ORIGINAL RESEARCH

Effect of different storage conditions on physico-chemical composition and shelf life of persimmon fruit

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ABSTRACT

Persimmon is naturally divulged with bioactive molecules including tannins etc. and its utilization may be helpful to reducing the diabetes mellitus. Therefore this research study was carried out to enhance the shelf life of persimmon fruit at refrigeration and ambient temperature (Temperature 20-23oC Relative humidity 60-63%) during storage. The quality attribute such as weight loss, TSS (°Brix), pH, titrable acidity total tannin (mg/100g) and ascorbic acid were studied at an interval of 3 days for a total period of 12 days. However, the treatment of T5 (sun dried + low density polyethylene) was superior to all other treatments in retention of vitamin C, total soluble solids, titratable acidity, total tannin and pH with minimum weight loss compared to control whereas the treatment T6 (oven dried + HDPE) was found better to all other treatments during storage. The treated persimmon fruit have increased storage life as compared to control. Present study was proved helpful to evaluate the effect of storage condition on physico-chemical composition and increase the postharvest life of treated fruits during storage.

Keywords: Persimmon, storage life, storage conditions, physic-chemical composition.

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Introduction

Persimmon (*Diospyros kaki L*.) is deciduous medium size fruit tree. It was first originated in China and then introduced in Japan about 750 A.D. that is why it is called as Japanese persimmon. It is extensively cultivated in Japan, USA, India, China and Pakistan (Itamura *et al*., 2005; Yokozawa *et al*., 2007). In recent years persimmon production and consumption has increased in the world. World-wide production of persimmon is increasing with the passage of time i.e. its production was 2,417,602 tons in 2000 which has increased to 3,263,021 tons in 2005 and more than 4,000,000 tons in 2010 (FAO, 2010).

In Pakistan, this fruit gaining more popularity. It is cultivated in cool subtropical regions of Malakand, Mardan, Hazara, Peshawer, Taxila, Rawalpindi, Chakwal and Jhelum Division. It gives flowers late in the spring and ripens early to late October (Ali *et al.,* 1999). Some varieties grown in Pakistan are Hachiya, Fugu, Aman Kaki, Marko, Italy, Jiro and Gosho (Ali *et al.,* 1999). The variety which is cultivated on commercial basis is flat in shape and become in deep orange color on ripening. This variety is seedless but quit astringent and having berry like structure varies in shape, size, color and quality. The fruit is ready for picking in last week of October. Persimmon is normally yellow orange to red orange in color, depending on the variety, varies in size from 1.5 to 9 cm diameter, and may be spherical, acorn, or pumpkin in shape. The calyx remain attached to the fruit after harvesting, but easy to take away as it ripens (Gorinstein *et al.,* 1998).

Persimmon can be classified in two groups: Astringent and non-astringent. Astringent may not be used before ripening due to their high level of soluble tannins, whereas non-astringent varieties can be used before ripening. It is a good source of carbohydrates, organic acids, vitamins (mainly A and C), minerals, phenolic compounds, dietary fiber and carotenoids (Homnava *et al.,* 1990). Glucose and fructose are main sugar in persimmon fruit by a ratio of more than 90% of total sugars. Sucrose found in minor level (Ito, 1971).

Persimmons have great industrial value, because it can be frozen, canned or dried. In oriental countries, consummation of dried persimmons is already a practice. Dried persimmons provide good sensory attributes and could be a valuable source of vitamin A and ascorbic acid (Nicoleti *et al.,* 2004). The most attractive industrial use of persimmons processing is drying technique. In fact, the Japanese and Chinese have always peeled, cut and sun dried persimmons (Brackmann *et al.,* 1997). High temperatures are frequently used for drying that decrease tannin contents, whereas sugars occurred in the fruit radiate to the surface where they crystallize, that provides a sweet, tasteful and non-astringent dried product. One of the main advantages of persimmon drying is that is removes astringency (Marder and Schoemaker, 1995).

Persimmon is widely grown in different areas of Azad Jammu and Kashmir and in the present studies during surveying it was observed that it is found in Hurnamaira, Ternuti, Datot, Jihri, Drake, Datot, Panyola, Khrick, Char, Parat, Rehara, Mallot, Harighal, arja, kayyat, Dhamni, Banjosa and many others areas in Azad Jammu and Kashmir but unluckily currently no research work available on post-harvest life of persimmon and literature about persimmon is almost silent in Azad Jammu and Kashmir. Peoples have lack of awareness, attention toward its proper harvesting, storage and utilization most of the fruit is wasted every year and no product is available in local market. In keeping in view this study was made to provide the knowledge about this fruit to local inhabitants and also supply this valuable fruit in local market by using cheap and simple techniques that helps to retain chemical composition and increase its storage life.

Materials and Methods

Collection of sample and preparatory operations

Persimmon fruits were harvested at ripening stage from different areas, like Hurnamaira, Ternuti, Datot, Jihri, Drak, Datot, Panyola, Khrick, Char, Parat, Rehara, Mallot, Harighal, arja, kayyat, Dhamni, and Banjosa of districts Poonch and Bagh, Azad Jammu and Kashmir. Harvested fruits were transported in polyethylene bags to the laboratory of the Department of Food Science & Technology, University of The Poonch, Rawalakot, Azad Jummu & Kashmir. Samples were washed with tap water and were dried and cleaned with muslin cloth. After drying and cleaning 400 fruits were selected and separated in three equal lots (hundred fruits for each lot). Lot one was used for fresh fruit, lot 2nd and 3rd were used for sun and oven dried. For sun drying persimmon fruits were cut into half then spread on plastic trays and left in open sun for drying. The trays were covered with muslin cloth to protect them from dust and flies. The persimmon fruits were turned occasionally until product was dried to the moisture level of 8-10 %. For oven drying fruits were cut into half and were placed on oven at 50˚C for 24 hours. Total seven different treatments were used. Treatments are followed as control (T_0), fresh fruit + low density polyethylene bags (at room temperature, T_1), fresh fruit + high density polyethylene bags (at room temperature, T_2), fresh fruit + low density polyethylene bags (at refrigeration, T_3), fresh fruit + high density polyethylene bags (at refrigeration, T_4), sun dried + low density polyethylene bags (at room temperature, T_5), oven dried + high density polyethylene bags (at room temperature, T_6). LDPE and HDPE have thickness of 10 µm and 30 µm respectively. Changes in some physical and chemical fruit properties were determined at three days intervals for a total period of 12 days.

Physical and chemical analysis

Weight loss percentage

AOAC (1990) method was used to measure the weight loss on electronic balance.

pH:

pH was measured with the help of pH meter and pH paper according to AOAC (1990).

Total Soluble Solids (TSS):

A refractometer was used to determine the soluble solids content according to AOAC (1990).

Titratable acidity %

Titratable acidity (expressed as malic acid) was determined by titrating 5 mL juice with 0.1N sodium hydroxide using phenolphthalein as an indicator (AOAC, 1990).

Ascorbic acid (mg/100g)

Ascorbic acid content was determined using 2, 6 dichlorophenol indophenols' titration methods as described by (AOAC, 1990).

Total tannins content

Total tannins content were estimated as mg per 100gm fresh weight using potassium permanganate volumetric method according to (Awan and Rehman, 1999).

Statistical Analysis

Data obtained from the study was statistically analyze using MSTAT-C software, for analysis of variance (ANOVA) by using 2-Factorial Complete Randomized Design (CRD) and Duncan's Multiple Range Test (DMRT) to evaluate the mean values according to method described by Steel and Torrie (1987) using MSTAT-C software (Michigan State University, 1991, United States of America).

Results and Discussion

Weight loss

Results indicated weight loss of persimmon fruit during storage. The maximum weight loss 10.20 percent was observed at 9th day of storage as compare to first day having 0.000 percent weight loss. DMRT test indicated that treatments are significantly different from each other. Treatments T_2, T_3 and T_4 (5.72, 5.84, 5.31) or T_5 and T_6 (3.15, 3.26) indicated less loss in weight as compare to control (Fig. 1). The minimum weight loss 3.152 was observed in T_5 followed by T_6 (3.262) percent during storage as compared to control having maximum weight loss (10.20 percent) and become unacceptable at 9th day of storage (Fig. 1). These results can be correlated with findings of Chaudhry *et al.* (1999) who had observed that persimmon had higher weight loss in control. These results are also in line with the finding of Dilawar *et al*. (2007) who had observed that persimmon had maximum weight loss in control as compare to fruits packed in polyethylene bags. Hussain *et al.* (2004) also observed that citrus fruits have maximum weight loss in control and minimum weight loss in thick polyethylene bag. Polyethylene might act as a Modified Atmosphere Packaging (MAP) that might have increased in relative humidity; CO_2 levels and decrease O_2 levels which reduce respiration rate and transpirations rate a result prevent water loss and maintain fruit quality (Ladaniya and Sonkar, 1997). These results are also in line with the findings of Ibrahim (2005) who had observed that polyethylene bags showed a significant decrease in weight loss in fruits. There was a rapid loss in weight in control treatment as compare to other treatments.

pH

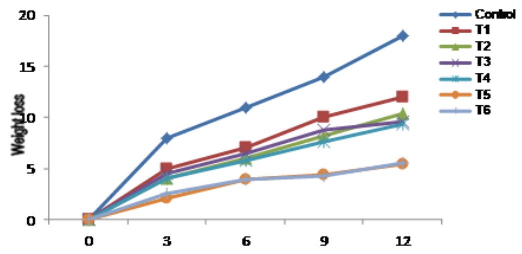

Fig. 1. Effect of different storage conditions on weight loss of persimmon fruit.

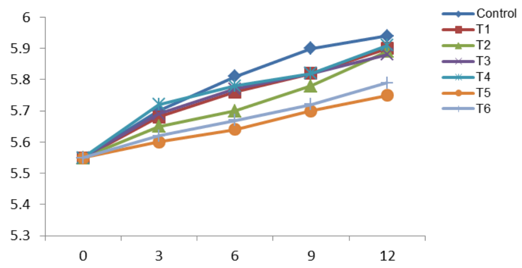

Fig. 2. Effect of different storage conditions on pH of persimmon fruit.

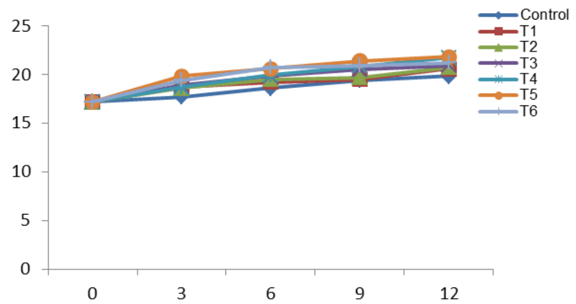

Fig. 3. Effect of different storage conditions on TSS (°Brix) of persimmon fruit.

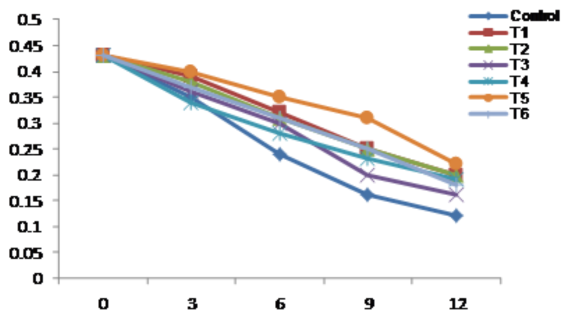

Fig. 4. Effect of different storage conditions on acidity percentage of persimmon fruit.

The results revealed that all treatments, storage intervals and their interactions were significantly different from each other. DMR test indicated a significant difference except T_1, T_3, (5.74) and T_4 (5.75). Data shows that there is an increasing trend of pH in persimmon during storage (Fig. 2). Minimum pH (5.64) was observed in T_5 followed T_6 (5.67) during storage. The minimum pH was observed in T_5 (5.64) might be due to the fact that less air was available in polyethylene for biochemical changes and conversion of acid into sugar resulting less increase in pH. Maximum pH was recorded in T_0 (5.78) Control during storage might be due to free atmospheric conditions of oxygen, temperature and humidity that caused more oxidation and degradation of acid as compare to pack fruits. Husssain *et al.* (2004) and Chaudhry *et al.* (1999) observed similar results. It is might be due to the fact that polyethylene package contributed to create modified atmosphere by increasing in CO_2 concentration as ethylene degraded into CO_2 and water cause slow increase in pH during storage (Hayat *et al.,* 2005).

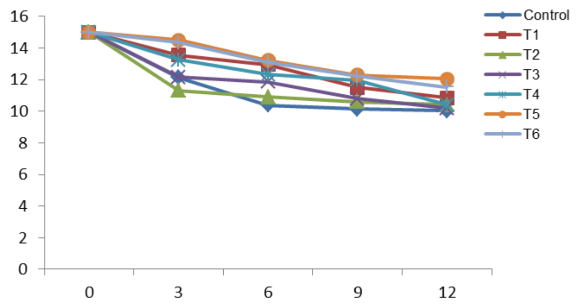

Fig. 5. Effect of different storage conditions on ascorbic acid content of persimmon fruit.

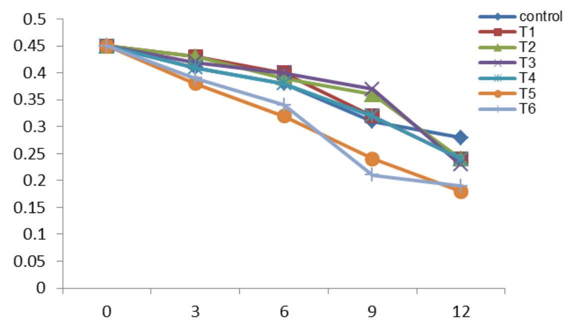

Fig. 6. Effect of different storage conditions on tannin contents of persimmon fruit.

Total Soluble Solids (TSS)

The result revealed that all treatments, storage intervals and their interactions had highly significantly affect on total soluble solids contents. DMR test shows that maximum TSS was in T_5 (20.16), followed by T_4 (19.66), T_3 (19.46), T_2 (19.14) and T_1 (19.04) as compare to control having lower concentration of TSS (18.540) during storage (Fig. 3). The highest retention of total soluble solid contents in treated fruits with the combination of polyethylene bags was might be delay in ripening process in modified atmosphere having lower ethylene level and decrease in respiration or other metabolic process during storage. These results are in line with Arthey and Philip (2005) who noticed that higher retention of total soluble solids is due to slower alteration in cell wall structure and breakdown into simple sugar. These results also in agreement with Mohla and Sing (2000). These results also in line with Candir *et al.* (2009) who described that The enhancement in TSS content might be due to result of deprivation of starch during later stage of harvest maturity.

Titratability acidity

The results revealed that all treatments and their interactions had significant difference on percent acidity of persimmon from each other except expect T_1 (0.31) and T_2 (0.31). It is clear from DMR test that maximum acidity 0.34 percent was recorded in T_5 followed by T_2 and T_1 (0.31) percent whereas the minimum 0.26 percent acidity was observed in T_0 (control) followed by T_3 (0.29) and T_4 (0.30) percent during storage (Fig. 4). The retention of titrable acidity was higher in fruits packed in polyethylene bags it is might be due to the reason that reduction in metabolic changes of organic acid into carbon dioxide and water. These results are agreement with Naweto *et al.* (2013) and Chaudhry *et al.* (1999). Minimum acidity was observed in T_0

(control) might be due to more oxidation as fruit ripens it diminished its malic and citric acid contents due to microbial activity (Martinez *et al*., 1997). Husssain *et al.* (2004) also observed the same behaviour in citrus fruit.

Ascorbic acid

The amount of ascorbic acid (mg/100g) was significantly affected by the treatments and their interactions. Maximum ascorbic acid was (13.41 mg/100g) was recorded in T_5 followed by T_6 (13.23 mg/100g), T_1 (12.77 mg/100g) and (12.58 mg/100g) in T_4 whereas the minimum (11.53mg/100g) was observed in T_0 (control) followed by T_2 (11.64 mg/100g), and T_3 (11.99 mg/100g) during storage (Fig. 5). Fig. 5 shows that higher retention of ascorbic acid was in T_5 (13.41 mg/100g). These results are in line with Rathore *et al.* (2007) and Saira *et al*. (2009). This retention of ascorbic acid is might be due to lowering of respiration of fruit or oxidation of ascorbic acid, which had reduced the loss of ascorbic acid contents. This is an agreement of those of Kalt (2006). Minimum ascorbic acid was (11.53mg/100g) observed in T_0 (Control) because oxidation of ascorbic acid was higher in control that cause rapid decrease in ascorbic acid during storage. These results are in line with the findings of Dorria *et al.* (2011) and Adisa (1986) who described that Fruits and vegetables shows a gradual decrease in ascorbic acid content as the storage duration increases. Ball (1997) also reported that ascorbic acid is highly water soluble vitamins that are easily oxidized during storage.

Total Tannins

The present investigations are clearly indicated that total tannins contents of persimmon fruit decrease during storage (Fig. 6). It decreases from 0.45-0.24 during storage. Same results were supported by Dorria *et al.* (2011), who reported that persimmon total tannins contents decrease with the advancement of storage period. DMRT test revealed that that all treatments, storage intervals and their interactions were significantly different from each other. Results show that maximum tannins were observed in T_3, T_2 and in T_1. Whereas, minimum tannins were observed in T_5, T_6 (0.31) and in T_1 (0.30). These results are in line with Bibi *et al.* (2007) who reported that some astringent fruits show decrease in tannins during ripening due to decrease in polymerization accompanied by loss in fluidity. This process caused a decrease in fruit astringency. These results are also in line with El-Wahab (2017) who found that persimmon tannin decrease with the advancement of storage. Candir *et al.* (2009) found similar results in persimmon fruit. Shela *et al*. (2001) described that one of the main advantages of drying of persimmon is that it removes astringency from the fruit.

Conclusion

Persimmon fruits were stored at different conditions and during this period its physico-chemical attributes were investigated for twelve days. During this study, treatment sun dried + LDPE + room temperature (T_5) was best with the advancement of time whereas, T_6 (oven dried + HDPE + room temperature) was also better to maintain the quality attributes. Further study will be made to evaluate the effect of dried persimmon on diabetic peoples.

Conflict of Interest Statement

The authors declare that they have no conflict of interest.

Acknowledgments

This research work was kindly supported by the University of the Poonch, Rawalakot, Azad Jammu and Kashmir.

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