Research Article

Post-harvest life of Persimmon (*Diospyros kaki* L.) as affected by coating materials and storage intervals

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Abstract

The research study entitled “Post-harvest life of persimmon (*Diospyros kaki* L.) as affected by coating materials and storage intervals” was conducted at post-harvest laboratory, Department of Horticulture, The University of Agriculture Peshawar, during the year 2015. The research work was conducted in Complete Randomized Design (CRD) with three replications and two factors i.e. storage intervals (0, 15, 30, and 45 days) and coating materials (Soya bean and Corn oil). The fruits of persimmon coated with soya bean oil increase TSS (11.53⁰Brix), taste (5.17) and moisture content (31.58%), while fruit store for zero days fruit decay (10%), weight loss (0%), less firmness (1.43 kg/cm²) and more moisture content (35.16%), however on 30 days storage more TSS (15.13⁰Brix) and taste (6) was observed. The fruit store for 30 days and soya bean coating perform better on all the parameter, so recommended for post-harvest life extension of persimmon fruits.

Keywords: Persimmon; Post-harvest; Storage; Coating; Soya bean oil; Corn oil

Introduction

The persimmon (*Diospyros kaki* L.) a fruit of Japanese origin [1] belong to family (Ebenaceae), was introduced in Khyber Pakhtunkhwa of Pakistan in 1940. The temperate and subtropical agro-climatic conditions of this province are well suited to this fruit. The major production areas include Peshawar, Mardan, Malakand, Dir and Swat fruit valleys [2]. This is a fair source of ascorbic acid and sugar and the sugars are present in the form of glucose and

fructose [1]. These fruits vary in size from 1.5 to 9cm (0.5 to 4 in) diameter and come in different shapes like spherical, acorn or pumpkin. The nutritional assessment of fruit had shown it to be good source of ascorbic acid, mineral, fibers and Carotenoids [3]. As in the case in other climacteric fruit [4], ripening in persimmon is associated with a loss of firmness, changes in pigment content, and increase in total soluble solid (TSS) concentration [5]. It is very susceptible to physiological damage,

particularly skin and flesh discoloration during storage. These injuries may be related to field factors and low storage temperature [3]. Persimmon generally has limited storability and a short shelf life [6]. Fuyu persimmon can only be stored for 2 months under regular air storage at 0 to 2°C and 90% relative humidity [7], while Triumph persimmon stored for 4 months in modified atmosphere packaging (low density polyethylene bags) at -1°C maintained adequate firmness, but accumulation of acetaldehyde caused fleshed browning. Agro climatic conditions of Pakistan ranging from tropical to temperate allow growing 40 different kinds of corns and 21 types of fruits. Post-harvest losses in fruits and corns range 25-40% [3], these losses bring low return to grower, processor, traders and country also suffers in terms of foreign exchange earnings. Efforts are being made both at federal and provincial level to minimize these losses safe guards the interest of growers, processors, retailers and consumers. However, the primary objective of research and development activities on post-harvest handling and quality preservation of soya bean, corns and fruits being carried out in the country is our national food security of to promote export of these high value commodities to other countries. In Pakistan 20-40% of fruits losses of fruits occurs are due to improper management of post-harvest operation and lack of advance techniques. For this reason the present study was designed to find out the best storage time and variety for prolonging the post-harvest life of persimmon fruits.

Materials and methods

The research entitled “effect of coating material (soya bean oil and corn oil) on the storage life of persimmon” was conducted at post-harvest horticulture laboratory, the University of Agriculture Peshawar. Persimmon (Hachiya) fruits were harvested at mature light yellow (unripe) stage from

newly development Research Farm, The University of Agriculture Peshawar KPK. Persimmon fruit were carefully transported to post-harvest horticulture lab in wooden boxes. Evaluations for physical properties were carried out in Horticulture Lab, The University of Agriculture Peshawar KPK. Defective fruits including wounded and other disorders were excluded. Fruits were washed with running tap water. Fruits were kept in storage room at ambient temperature (21 °C). Fresh fruits were tested for their weight loss (gm), firmness (kg/cm²) and shelf life. The fruits were coated with oil and stored for a period of 45 days.

Experimental design

The experiment was laid in Completely Randomize Design (CRD) with two factors i.e. coating (Soya bean and Corn oil) and days to interval (0, 15, 30 and 45 days), and repeated three time. Total number of experimental units was 24 and each experimental unit having 60 fruits. Data recorded on 5 fruits randomly selected from experimental unit for comparison after 15 days of testing both the coating materials. It was tested four times in the experiment. Data were recorded on taste, firmness (kg/cm²), weight loss percent, moisture contents percent, decay fruits percent and total soluble solids (TSS).

The following parameters were studied in this experiment

Fruit decay (%)

The number of decayed fruits due to fungus or any micro-organisms infection was recorded at days 0, 15, 30 and 45, which were compared with a day 0, and calculated as a percentage of the total number of fruits using the following equation

$$\text{Decay Percentage} = \frac{\text{Total number of decayed fruits}}{\text{Initial number of stored fruits}} \times 100$$

Total soluble solids (⁰Brix)

Total soluble solids (TSS⁰Brix) were determined at a room temperature of 21°C,

with a hand refractometer using 2 to 3 drops of juice obtained by squeezing the fruits [8].

Fruit firmness (Kg cm⁻²)

Firmness was determined using Penetrometer (Effgies, FT-011). Fruit surface was peeled with the help of blade, set the Penetrometer on zero error, then pushing the Penetrometer hanger on the peeled surface, and note the reading in unit kg cm⁻². After each 15 days interval, five fruits were randomly selected from each lot and their firmness was determined by pressing the knob of the Penetrometer into the fruit. The average of these five was the firmness of the whole lot.

Weight loss determination (%)

The weight loss during storage was determined by the weight differences at 15 days intervals, which were then compared with day 0, and expressed in percentage (fresh weight basis). Fruit was weighted using a weighing scale. Fruits weight was recorded, then the percentage of weight loss were calculated according to the following equation

$$\text{Fruit weight loss \%} = \frac{(W_i - W_s)}{W_i} \times 100$$

W_i = Fruit weight at initial period

W_s = Fruit weight at sampling period

Taste

Organolaptic test of the fruit was done to identify their taste on five fruits, so the three judges give the marks from (1-10) and it was on this manner that poor taste having marks from 1-2, fair have 3-4, good have 4-6, very good have 6-8 and excellent have 8-10 marks.

Moisture content (%)

Weight moisture sample immediately and record as “wet weight of sample” Dry the weight sample again to a constant weight, at a temperature not exceeding 90°C using the suitable drying equipment. Allow the sample to cool. Weight the cooled sample again, and recorded as the “dry weight of sample”. The moisture content of the five randomly

selected samples was calculated using the following equation.

$$\text{M.C (\%)} = \frac{A-B}{A} \times 100$$

M.C (%) = Percentage of moisture in the sample

A= weight of wet sample (gram)

B= weight of dry sample (gram)

Statistical analysis

The data recorded on different parameter were analyzed by using the statistical computer software, MSTATC (Michigan state university, USA). Analysis of variance (ANOVA) and LSD test were performed to find out the difference between treatments and interaction. The mean values for difference were compared by using least Significant Difference Test [9].

Results and discussion

Fruits decay (%)

Data regarding fruit decay (%) were significantly affected by storage intervals, while coating materials were found non-significant (Table 1), and also interaction was found significant. Maximum decay of fruits (84.14 %) were noted at 45 days storage duration, while lowest fruits decay (10 %) were obtained on 0 days of storage interval. Soya bean oil and storage duration on 0 days had minimum fruits decay as compare to remaining storage condition and corn oil coating, as so storage interval increase will increased fruits decay (Figure 1). During the storage duration fruits decay reduces in initial days of fresh commodities and having all the physiological attributes are more in the fruits. Antifungal appearance [10], and antimicrobial activities is higher, when the respiration is more and loss of sugar [11]. Disruption and death of the microbial cells decay of fruits faster [12]. [13] Found that, chinitin contents of cell wall reduce loss of fruits from fungal infection. Similar studied were observed by [14, 15] that pathogenic microorganisms were restricted when mango fruits were coated with Chitosan. The storage life of

persimmon fruits might be increased if the fruits are higher in calcium concentration in

the plants storage life increase after removing from plants and store for later use.

Table 1. Storage condition and coating materials affected Fruits decay (%), TSS ($^{\circ}$ Brix), Weight loss (%), Taste (%) and Moisture content (%) of persimmon fruits

Coating	Fruits decay (%)	TSS ($^{\circ}$ Brix)	Parameters		Taste	Moisture content (%)
			Firmness (Kg cm $^{-2}$)	Weight loss (%)		
Soya bean Oil	44.91 b	11.53 a	3.58 a	16.44 a	5.17 a	31.58 a
Corn Oil	44.41 a	10.49 b	3.36 a	16.54 a	4.08 b	30.50 b
LSD _(0.05)	ns	0.44	ns	ns	0.62	0.63
Storage interval (Days)						
0	10 d	8.49 c	1.43 d	0 d	3.50 c	35.16 a
15	53 b	9.00 c	2.72 c	14.07 c	3.93 c	29 c
30	31 c	15.14 a	5.40 a	21.30 b	6.00 a	31.50 b
45	84.16 a	11.44 b	4.33 b	30.60 a	5.08 b	28.50 d
LSD _(0.05)	3.55	0.87	0.5	1.65	0.88	0.90
Interaction (Coating x Storage Intervals)						
LSD _(0.05)	5.03	0.88	ns	ns	ns	1.27

Means followed by similar letters are statistically non-significant / similar at 5 % level of significance

Figure 1. Interactive effect of coating materials and storage intervals on fruit decay percentage 1), interaction (Coating x Storage interval)

TSS ($^{\circ}$ Brix)

Coating materials of persimmon fruit significantly affected total soluble solid ($^{\circ}$ Brix) at different storage intervals (Table

were also found significant (Figure 2). Total soluble solid (11.54 $^{\circ}$ Brix) in highest concentration were calculated in soya bean

oil coating and lowest concentration (10.5°Brix) in corn oil coating, while storage duration maximum amount of TSS (15.14°Brix) was found that store for 30 days and lesser amount (8.50°Brix) observed which stored first days. Interaction of coating materials and storage duration showed that soya bean oil had maximum fruit TSS ($^{\circ}\text{Brix}$) when stored for 30 days. Nature of TSS during the ripening of climacteric fruits increased significantly,

mainly from the conversion of starch into simple sugars such as glucose, fructose and sucrose that causing in the flavor [16]. It might be in later stages of storage increase in ethylene synthesis due to respiration total soluble solid increased. Variety of persimmon no variation in the levels of TSS during the ripening, but the ethylene level increased starting from 6 days of ripening and leads to increase in TSS because persimmon is a climacteric fruit.

Figure. 2. Interactive effect of coating materials and storage intervals on TSS ($^{\circ}\text{Brix}$)

Firmness (Kg/cm^2)

Data pertaining firmness significantly affected by storage intervals, while coating and interaction was found non-significant (Table 1). Soya bean oil coating fruits contains highest firmness ($3.58 \text{ kg}/\text{cm}^2$) as the firmness ($3.36 \text{ kg}/\text{cm}^2$) in corn oil coating. Maximum fruit firmness were calculated when the fruits are harvested time ($5.40 \text{ kg}/\text{cm}^2$), while the lesser fruits firmness ($1.43 \text{ kg}/\text{cm}^2$) were obtained when the fruits are store for 30 days. Softening of the fruits, loss of color, physiological changes, ethylene production and ripening process of the fruits causes firmness [17]. Degree of methylation varied firmness from green and ripe fruits mainly due to protein polymers [18], calcium which maintain adjacent chains bonded among themselves,

also glycoside chains interconnected among themselves by phenolic compounds [19].

Hydrolytic enzyme activation due to ripening increased firmness that promotes intense solubilization of pectin present in the cell wall, mainly pectin methyl esterase (PME) and polygalacturonases (PG). High esterase activities in the cell wall of persimmon kernel suggest that rapid decrease in firmness [20]. It might be due to in the initial stages firmness more and ripening increase with decrease the firmness of persimmon fruit if storage time increased.

Weight loss (%)

Persimmon fruits store for different days were significantly affected weight loss (%), while coating and interaction has non-significant effect on weight loss percentage of persimmon fruits at room temperature (Table 1). There were no difference among

coating with soya bean oil weight loss (16.54%) and corn oil (16.44%) weight loss. Weight loss (30.60%) rapidly reduced if the fruit of persimmon store for 45 days while at first day of storage the no weight loss were obtained. Loss of water from the surface of fruits, cell wall degradation, rapid respiration and ethylene concentration results to weight loss of fruits [15]. Storage of persimmon fruits period increase with increased in Cumulative Physiological Loss in Weight (CPLW). It might be due to increase in ethylene, respiration and loss of moisture from the surface of fruits cause significant loss in fruit weight of persimmon.

Taste

Data recorded on taste were significantly affected by both coating and storage of fruits time, and interaction among these found non-significant (Table 1). Taste of soya bean oil coating (5.17%) was found more than corn oil coating (4.08%). The fruits are stored for 30 days result more taster (6%) as compare to fruits store harvesting stage (3.50%). Maturity cause increase in sugar and decrease in acidity the taste of fruits better as compare to time of harvesting [21]. Taste retain higher with acid concentration [22]. Malic acid, citric and quinic acid have a significant effect on taste and flavor of the fruits. Ripening consumed these organic

acid and sugars efficiently enhance the taste and flavor. [23] reported that, during the storage change in acidity is due to increase in metabolic activities of living tissues. Organolaptic characteristics maintaining by the physiochemical properties of the treatments retained.

Moisture content (%)

Data on moisture content were significantly affected by coating materials on persimmon and storage intervals, also interaction among these treatments were found significant (Table 1). Moisture content was found higher in soya bean oil coating (31.58%), while coating with corn oil contain less amount of moisture (30.50%), and fruits store for 45 days moisture concentration were decreased (28.50%) while increased moisture in the initial stage of storage (35.16%). Soya bean oil coating and their interaction with fruits store in zero days more moisture were calculated (Figure 3). Weight loss decreased regularly having direct effect on moisture contents. Increase in weight loss, reduced metabolic activity and moisture loss from skin of the fruits [24]. Moisture levels totally depend on storage temperature and water pressure gradient between the fruit tissue and the surrounding atmosphere [25].

Figure 3. Interactive effect of coating materials and storage intervals on moisture content

Conclusion

The experimental result showed that both the coating materials were significantly influenced the TSS (%), taste and moisture content (%), while firmness (kg/cm^2), fruit decay (%) and weight loss (%) was found non-significant. Also storage interval significantly affected all the parameters. Interactive effect of varieties and storage intervals significantly affected all the parameters except firmness (kg/cm^2), taste and weight loss (%). Recommendation of soya bean oil coating and fruits store for 30 days for post-harvest life extension of persimmon fruits.

Authors' contributions

Conceived and designed the experiments: N Shah & F Bibi, Performed the experiments: N Shah, S Zeb, M Khan, S Rawan & N Khan, Analyzed the data: T Ahmad, F Ghafoor & U Anwar, Contributed reagents/materials/ analysis tools: S Faisal, J Iqbal & F Ullah, Wrote the paper: N Khan.

References

1. Itoo S, Nagy S & Shaw PE (1980). Tropical and subtropical fruits, compositions, properties and uses. AVI Publ. Co., Westport, CT. Persimmon. Pp. 442-468.
2. Khan R & Jan T (1980). Planting and management of persimmon orchards in KPK. Dep. of Agric. Agric. Res. Inst. Tarnab, Farmer's Bulletin. No. 2.
3. Wills RBH, Joyce DC, McGlasson WB & Graham D (2007). Physiology and biochemistry, In: Post-harvest an Introduction to the physiology and handling of fruit, vegetables and ornamentals. 5th edition. UNSW Press. UK. pp. 28-51.
4. Kader AA, Kasmiree RF, Mitchell FG, Reid MS, Sommer NF & Thompson JF (1985). Post-harvest technology of Horticulture Crop. Univ. of California, Spec. Publ. 3311, Berkely CA 12: 511-520.
5. Moon BW, Lims ST, Choi JS & Suh YK (2000). Effects of pre or post-harvest application of liquid calcium fertiliser manufactured from oyster shell on the calcium concentration and quality in stored 'Niitaka' pear fruits. *J Korean Soc Hort Sci* 41: 61-64.
6. Kitagawa H & Glucina PG (1984). Persimmon culture in New Zealand. New Zealand Department of Scientific and Industrial Research, Information Series. pp. 159.

7. Cia P, Benato EA, Sigrist JMM, Sarantopoulos C, Oliveira LM & Padula M (2006). Modified Atmosphere Packaging for Extending the Storage Life of 'Fuyu' Persimmon. *Postharvest Biol. Tec.* 42: 228-234.)
8. AOAC (1984). Official methods of analysis, 14th Ed. Association of Official Analytical Chemists, Washington, D. C.
9. Steel RGD, Torrie JH & Dickey DA (1997). Principle and procedure of statistic. A biometrical approach, 3rd ED. MCGRAW Hill Book Co. Inc. New York. pp. 172-177.
10. Hernandez AN, Hernandez M, Velasquez MG, Guerra MG & Melo GE (2007). Activated antifungica del quitosano enel control de *Rhizopus stolonifer* (Ehreneb. FR.) Bully *Mucor* spp. *Rev Mex Fitopat* 25(2): 109-113.
11. Gil G, Monaco DS, Cerruti P & Galvagan M (2004). Selective antimicrobial activity of Chitosan on beer spoilage bacteria and brewing yeast. *Biotechnol Lett* 26(7): 569-574.
12. Helander IM, Lassila ELN, Ahvenainen RN, Rhoades J & Roller S (2001). Chitosan disrupts the barrier properties of the outer membrane of Gram-negative bacteria. *Int J Food Microbial* 71(2-3): 235-244.
13. Abbasi NK, Iqbal Z, Maqbool M & Hafiz IA (2009). Post-harvest quality of mango (*Mangifera indica* L.) fruit as affected by Chitosan coating. *Pakistan J Bot* 41(1): 343-357.
14. Wang J, Wang B, Jiang W & Zhao Y (2007). Quality and shelf life of mango (*Mangifera indica* L. cv. Tainong) coated by using Chitosan and polyphenols. *Food Sci Technol Int* 13(4): 317-322.
15. Zhu X, Wang Q, Cao J & Jiang W (2008). Effects of Chitosan coating on post-harvest quality of mango (*Mangifera indica* L. cv. Tainong) fruits. *J Food Process Press* 32(5): 770-784.
16. Chitarra MIF & Chitarra AB (2005). Pos-colheidade fructose hortalias, physiological mango. 2. ed. Larvas, UFLA, pp. 785.
17. Oliveira ACG (2006). Conservacao pos-colheita de goiaba branch Kumar poor irradiance gamma: aspects fiascos, químicos e senioritis. *Boletim CEPPA* 24(2): 375-396.
18. Fertoni HCR (2006). Estabelecimento de um modelo de extracao acida de pectina de bagaco de maca. Dissertacao (Mestrado em Ciencia e Technology de Alimentos)-Universidade Federal de Ponta Grossa, Ponta Grossa. pp. 82.
19. Taiz L, Zeiger & Fisiologia E (2004). Vegetal. 3. ed. Porto Alegre: Artmed. pp. 719.
20. Jain N (2001). Compositional and enzymatic changes in guava (*Psidium guajava* L.) fruits during ripening. *Acta Physiological Planetarium* 23: 357-362.
21. Bhattacharya G (2004). Served Fresh Spot light Times Food Processing Journal. http://www.timesb2b.com/foodprocessing/dec03_jan04/spotlight.html.
22. Ramana KVR, Setty GR, Murthy NVN, Saroja S & Najundaswamy AM (1979). Effect of ethephone, benomyl, thiobendazole and wax on color and shelf life of coorg. Mandarin (*Citrus reticulata* Blanco). *Trop Sci* 21: 265-27.
22. Ulrich R (1970). Organic acids in the biochemistry of fruit and their products. Academic Press, New York, USA 1: 89-115.
24. Alves RE, Filgueiras HAC, Almeida AS, Pereira MEC, Cocozza FM & Jorge JT (2004). Post-harvest ripening of 'Tommy Atkins' mangoes on two maturation stages treated with 1-MCP. *Acta Hort* 645: 627-632.
25. Munoz PH, Almenar E, Valle VD, Velez D & Gavara R (2008). Effect of Chitosan coating combined with post-harvest calcium treatment on strawberry (*Fragaria ananassa*) quality during refrigerated storage. *Food Chem* 110(2): 428-435.