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Changes in some physical characteristics of persimmons (*Diospyros kaki* L.) subjected to different treatments and storage periods

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Abstract
In this study, changes in some physical properties of persimmons cv. 'Fuyu' fruits stored under normal atmospheric conditions were investigated. Before storing, fruits were divided into 4 groups as control, hot water, low O_2 and 1-Methylcyclopropene (1-MCP) treatments. The fruits in each treatment were packed in 3 foam packages, each containing three fruits, for 3 months in normal atmospheric conditions at 0±1°C temperature and 90±5% relative humidity. Fruit physical properties (axial dimensions, sphericity, fruit volume, surface area, shape index, projected area, weight, bulk density, fruit density, porosity, fruit flesh firmness, fruit skin colour and amount of total soluble solids) were examined monthly from the beginning of storage. The lowest loss in the geometrical dimensions and gravimetric properties of persimmons cv. 'Fuyu' at the end of 90-day storage was determined in the fruits in low O_2 treatment. However, hot water treatment gave the best results regarding the changes in the parameters of total soluble solids, fruit flesh firmness and colour.

Keywords: Persimmons, geometric dimensions, fruit weight, bulk and fruit densities, porosity, fruit flesh firmness, fruit colour, total soluble solids

1. Introduction
Persimmons (*Diospyros kaki* L.) is a perennial, subtropic and warm temperate climate plant. The homeland of persimmons is China. China, Japan and South Korea make up approximately 87% of world production (Tangu *et al.,* 2010) [21]. The worldwide production in 2016 was 5 million tons and Turkey is the 7th biggest persimmons producer with a production quantity of 38,043 tons following China, Japan, South Korea, Brazil, Italy and Israel (FAOSTAT, 2016) [10]. In Turkey, persimmons is most widely grown in the Mediterranean Region. As this fruit cultivar defoliates in winter, it is also cultivated in cooler regions, especially in the Black Sea, Aegean and Marmara Regions.

The most significant post-harvest problems related to persimmons are grading, handling, packaging, storage, marketing and transportation. These problems which originate from the short shelf life of persimmons and the quality losses caused by different reasons (weight loss, fruit softening, changes in fruit colour, etc.) reduce its marketing value. Cooling the harvested fruit as soon as possible is important in terms of protecting the quality and reducing the postharvest quality losses. It will be possible to eliminate or minimise the problems encountered after harvest by means of postharvest treatments on the fruits (hot water, low O_2 and 1-MCP treatments).

The physical characteristics of persimmons are important for harvesting, handling, classification, sorting, processing, packaging and storage equipment. It should be noted that the systems which are not compatible with the characteristics of agricultural products will not allow an effective treatment. Being aware of biotechnical properties (physical, mechanical and chemical properties) of persimmons will reduce the product losses in the operations during and after harvest and improve the operation performance and productivity.

In recent years, researches related to physical, mechanical and chemical properties of various fruits were made by a number of researchers. Researches carried out on chemical properties have been conducted for various fruits, such as rosehip (Demir and Ozcan, 2001) [7], cherry (Çalışır and Aydın, 2004) [4], orange (Topuz *et al.,* 2005) [22], plum (Ertekin *et al.,* 2006) [9], strawberry (Özcan and Hacıseferoğulları, 2007) [18], kumquat fruit (Jaliliantabar *et al.,* 2013) [11] and goldenberry (Yıldız *et al.,* 2015) [25] fruits.

The physical, chemical and mechanical properties of 'Fuyu' and 'Hachiya' persimmons were investigated by Celik and Ercisli (2008) [5] and Altuntas *et al.* (2008; 2011) [2, 3]. On the other hand, Koyuncu *et al.* (2005) [12] investigated the changes in physico-chemical properties of 'Fuyu', 'Hachiya' and 'Turkay' persimmons related to cold storage (Koyuncu *et al.*, 2005) [12]. The researchers kept the fruits in a cold store in 2 kg perforated polyethylene bags for 3 months.

Despite all these researches, no study was found in the literature investigating the changes in the physical properties of persimmons fruits under four different treatment conditions (control, hot water, low O_2 and 1-MCP) and during 3 months of storage period.

In this research, changes in some physical properties of 'Fuyu' persimmons with a high commercial value were investigated under different treatment conditions (control, hot water, low O_2 and 1-MCP) and storage periods (30, 60 and 90 days). For this purpose, the treatments were compared by investigating the parameters such as the fruit's axial dimensions, sphericity, surface area, fruit volume, projected area, shape index, fruit weight, bulk density, fruit density, porosity, fruit flesh firmness, fruit skin colour and the amount of soluble solids.

Material and Methods

Sample preparation, treatment and storage conditions

The research material consisted of persimmons cv. 'Fuyu'. The fruits were picked from the production orchard of Yalova Atatürk Central Horticultural Research Institute. The optimum harvest time was determined considering the cultivar-specific size, shape and colour of the fruits. The fruits were harvested at the green-orange stage, in the middle of October. After harvest, the fruits were immediately taken to the Postharvest Physiology Laboratory of Horticulture Department at the Faculty of Agriculture, Uludag University, and the pre-storage treatments were performed. Pre-storage treatments made on the fruits were divided into 4 groups. These are the control, hot water, low oxygen and 1-methylcyclopropene (1-MCP) treatments. No treatment was performed on the fruits in the control group. The fruits, which were subjected to hot water treatment, were immersed in water at 48ºC for 10 minutes (Lee *et al.*, 2010) [14]. The fruits involved in low oxygen treatment were subjected to low oxygen at the concentration of 1.5% for a period of 48 hours (Orihuel-Iranzo *et al.*, 2010) [17]. For the treatment of 1-MCP, the fruits were kept in a leak-proof environment at the concentration of 625 ppb for 12 h under 20±1°C, and then the environment was vented for 30 minutes (Zhang *et al.*, 2010) [27]. Thereafter, the fruits in each treatment were packed in two foam packages, each containing 3 fruits. The packages prepared this way were placed in plastic boxes in groups of three and kept at 90±5% relative humidity and 0±1°C for 90 days under normal atmosphere conditions. The physical measurements, analysis and calculations of the fruits were made before the storage and then they were stored under normal atmosphere conditions. Axial dimensions, sphericity, surface area, fruit volume, projected area, shape index, fruit weight, bulk density, fruit density, porosity, fruit flesh firmness (FFF) the amount of total soluble solids (TSS) and fruit skin colour were examined on different treatment samples taken from the cold store each month.

Determination of dimension and gravimetric properties

The diameter and length of the fruits in each treatment were measured with digital calliper (with a precision of 0.01 mm) before storage. 'Fuyu' cultivar has two axial dimensions as the length and the width (which may be considered as diameter). The individual fruit weight for the fruits were determined with the weighing performed in electronic balance with a precision of 0.01 g (Radwag PS 3500/C1, Radom, Poland). Hectoliter container was used for the bulk density of the fruit; and liquid (water as the liquid) displacement method was applied for the true density of the fruit Celik and Ercisli (2008) [5]. Following equations were used in order to determine the geometric mean diameter, sphericity, surface area, fruit volume, porosity and shape index of the fruits in relation to the two axial dimensions (Mohsenin, 1986 [15]; Omobuwajo *et al.*, 1999 [16]; Unal *et al.*, 2008 [23]).

$$D_g = \left(LD^2\right)^{1/3} \quad (1)$$

$$\phi = \left(\frac{D_g}{L}\right) \quad (2)$$

$$S = \pi D_g^2 \quad (3)$$

$$V = \frac{\pi}{6}\left(LD^2\right) \quad (4)$$

$$\varepsilon = \left[1 - \frac{\rho_b}{\rho_f}\right].100 \quad (5)$$

$$I_s = \left(\frac{L}{D}\right) \quad (6)$$

where L is the length (mm), D is the diameter (mm), D_g is the geometric mean diameter (mm), ϕ is the sphericity (--), S is the surface area (cm^2), V is the fruit volume (cm^3), ε is the porosity (%), ρ_b is the bulk density (kg/m^3), ρ_f is the fruit density (kg/m^3) and I_s is the shape index (--).

Determination of projected area properties

The projected area of the persimmons fruit was determined by taking the photos of fruits with a digital camera (Sony DSC-W730, Sony Corp. Chine), after placing the fruits on a surface together with a stencil of which the reference area is known. The photographs of the fruits were taken from both surfaces on the longitudinal axis on a flat surface, and thereafter the average area of the two photos was taken. The projected area of the material was determined in comparison to the reference area, using Sigma Scan Pro 5 programme (SPSS Science, Chicago IL, USA) [5, 23, 25].

Determination of fruit flesh firmness properties

The fruit flesh firmness (FFF) properties of 'Fuyu' were determined with a biological material test device. The device has a capacity of 50 N and a precision of 0.01 N (Sundoo 50 SH Digital Push Pull Gauge, Wenshou, China). 1 cm diameter skin was removed from two opposing surfaces in the centre of the fruit samples and the firmness was measured.

Determination of total soluble solids and fruit skin colour properties

The amount of total soluble solids (TSS) was measured using a NOW (0-32%) (Tech-Jam International Inc., Tokyo, Japan) hand refractometer in the juice obtained from each treatment group of the fruits. The fruit skin colour was determined using Minolta CR-300 (Konica-Minolta, Osaka, Japan) colour reading instrument with the fruits taken from each treatment and storage period.

Statistical Analysis

The research was carried out with 3 replicates consisting of 3 fruits in each replicate, according to randomized plots factorial experimental design. The results obtained from the trials were evaluated according to LSD test at the level of 0.05.

Results and Discussion

Changes in geometrical dimensions during storage

Some geometrical dimensions during 30, 60 and 90 day-storage periods of persimmons cv. 'Fuyu' following 4 different treatments (control, hot water, low O_2, and 1-MCP) and their change ratios are given in Table 1 and Fig 1. As can be seen in the table, length of the fruit cv. 'Fuyu' was between 50.25-54.72 mm and fruit diameter between 71.64-80.87 mm, before storage. Mean geometrical diameter, sphericity, shape index, surface area and fruit volume values calculated according to the length and diameter of fruit were found as 63.38-70.69 mm, 1.242-1.296, 0.673-0.719, 126.5-157.4 cm^2 and 135.9-189.0 cm^3, respectively. Length, diameter, geometrical diameter, and sphericity values of the fruit were found similar to the results obtained by Altuntas *et al.* (2011) [3]. However, surface area and volume values of the fruit were higher than the results of Altuntas *et al.* (2011) [3]. It was determined that decreases occurred in the axial dimension values (length and diameter) measured in persimmons cv. 'Fuyu' fruits, depending on the storage period, and that these decreases were more prevalent in control and hot water treatment groups compared with the treatments of low O_2 and 1-MCP (Fig 1.). Some decreases occurred in the other geometric properties calculated according to two basic axial dimensions depending on the storage period. Shape index value of cv. 'Fuyu' was found between 0.67 and 0.72 (0.69 in average) (Table 1). When the shape index values of the fruit are examined, it can be said that 'Fuyu' cultivar is of flat structure. Alayunt (2000) [1] named the material as 'flat', when the length/diameter ratio of the material is between 0.4 and 0.7.

Table 1: Changes in some geometrical properties of the persimmon cv. 'Fuyu' during different treatments and storage periods.

Treatment	Storage period (day)	*L* (mm)	*D* (mm)	D_g (mm)	ϕ (%)	*S* (cm^2)	*V* (cm^3)
Control	0	50.25	71.64	63.38	1.261	126.5	135.9
	30	48.60	69.71	61.53	1.267	119.1	123.9
	Difference (%)	*3.40*	*2.77*	*3.00*	*0.47*	*6.21*	*9.65*
Hot water	0	54.67	76.11	67.86	1.242	145.1	167.0
	30	51.43	75.14	65.93	1.282	136.8	152.9
	Difference (%)	*6.29*	*1.29*	*2.93*	*3.12*	*6.01*	*9.27*
Low O_2	0	50.27	74.66	65.16	1.297	133.4	146.8
	30	49.38	74.17	64.49	1.306	130.7	142.4
	Difference (%)	*1.79*	*0.66*	*1.03*	*0.72*	*2.06*	*3.11*
1-MCP	0	54.72	80.87	70.69	1.292	157.4	189.0
	30	53.03	80.53	69.76	1.315	153.3	181.7
	Difference (%)	*3.17*	*0.41*	*1.33*	*1.79*	*2.68*	*4.04*
Control	0	52.65	75.93	66.92	1.271	140.8	159.3
	60	51.02	74.43	65.33	1.281	134.2	148.2
	Difference (%)	*3.20*	*2.02*	*2.43*	*0.81*	*4.93*	*7.51*
Hot water	0	52.37	75.18	66.35	1.268	138.5	155.6
	60	51.05	73.08	64.56	1.265	131.4	144.0
	Difference (%)	*2.58*	*2.89*	*2.78*	*0.22*	*5.46*	*8.05*
Low O_2	0	51.02	75.65	66.05	1.296	137.5	154.2
	60	50.92	74.03	65.05	1.281	133.4	147.5
	Difference (%)	*0.20*	*2.18*	*1.54*	*1.18*	*3.05*	*4.53*
1-MCP	0	53.15	77.47	68.01	1.281	145.8	168.3
	60	52.07	75.81	66.59	1.280	139.8	158.1
	Difference (%)	*2.08*	*2.19*	*2.14*	*0.11*	*4.28*	*6.44*
Control	0	52.40	74.95	66.23	1.265	138.0	154.8
	90	50.05	70.64	62.70	1.254	123.6	131.1
	Difference (%)	*4.70*	*6.10*	*5.63*	*0.87*	*11.64*	*18.07*
Hot water	0	52.27	74.55	65.94	1.262	137.1	153.8
	90	41.85	72.50	63.14	1.302	125.6	134.7
	Difference (%)	*7.73*	*2.83*	*4.44*	*3.11*	*9.16*	*14.20*
Low O_2	0	50.53	74.13	64.96	1.285	132.7	145.9
	90	49.22	72.49	63.44	1.290	126.6	136.0
	Difference (%)	*2.68*	*2.25*	*2.40*	*0.33*	*4.83*	*7.30*
1-MCP	0	52.25	76.60	67.14	1.286	142.1	162.2
	90	49.92	75.10	65.26	1.308	134.2	148.8
	Difference (%)	*4.67*	*2.00*	*2.89*	*1.70*	*5.88*	*9.00*

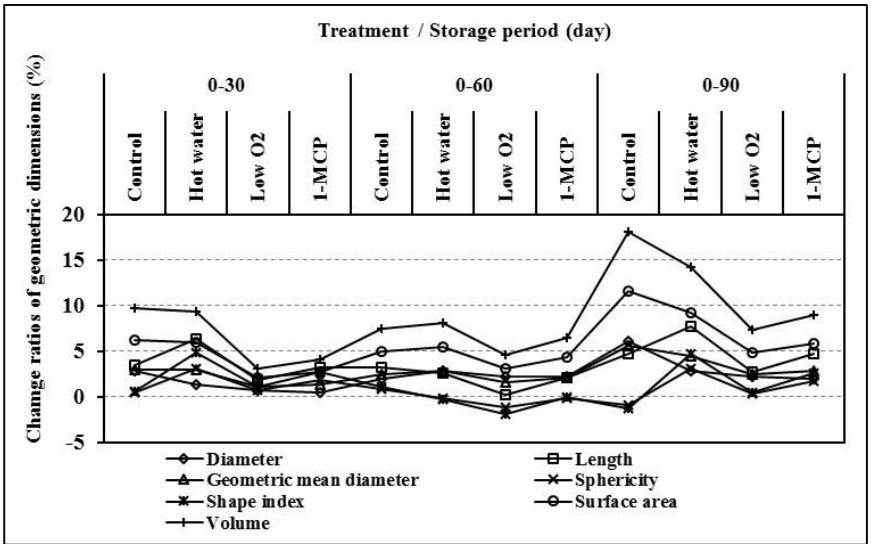

Fig 1: Change ratios in the axial dimensions, sphericity, shape index, surface area and volume of the persimmon cv. 'Fuyu' during the storage period

Changes in projected area during storage

The average projected area of 'Fuyu' cultivar before storage was approximately between 52 and 64 cm^2. At the end of the tests, this area was determined at the level of nearly 51-57 cm^2 (Table 2). The highest change in the projected area caused by the storage period of the fruit and different treatments was found in the control and hot water treatments. Reductions in the projected area which were 9 and 7% in the control and hot water treatments, respectively at the end of the 30 day-storage dropped at the level of 15 and 16.5%, respectively on the 90th day (Fig 2.). The best result here was determined in 1-MCP treatment (0.6% on the 30th day; and 3.3% on the 90th day). The projected area results obtained by Altuntas *et al.* (2011) [3] on their study on 'Fuyu' cultivar were found below the results obtained in our study (38.8 cm^2).

Table 2: Projected areas of the persimmons cv. 'Fuyu' during the storage period.

Storage period (day)	Treatment	Pre-storage projected area (cm^2)	Post-storage projected area (cm^2)
0-30	Control	59.2	53.8
	Hot water	55.5	51.7
	Low O_2	52.4	51.7
	1-MCP	58.2	57.8
0-60	Control	63.8	56.3
	Hot water	58.6	52.9
	Low O_2	61.3	57.3
	1-MCP	57.7	56.8
0-90	Control	60.9	51.7
	Hot water	63.9	53.3
	Low O_2	57.2	51.2
	1-MCP	58.4	56.5

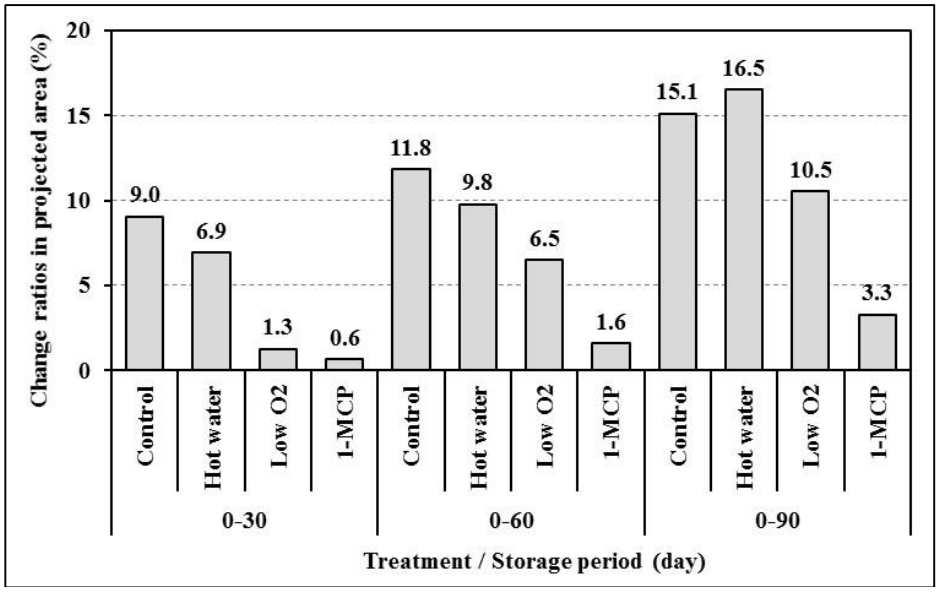

Fig 2: Change ratios in the projected area of the persimmons cv. 'Fuyu' during the storage period

Changes in fruit weight during storage

It was determined that increases occurred in the weight loss values in 'Fuyu' persimmons depending on the storage period, and that these losses were more prevalent in control and low O_2 treatment groups compared with the other two treatments (Fig 3. and Fig 4.). However, it can be seen from Fig 4 that no statistical differences were detected regarding weight loss between control and treatment groups, except 30 day-storage ($P<0.05$). The changes occurred in the weight of fruits support the thought that the hot water treatment has positive effects on the storage period of the treated fruits. Salvador *et al.* (2004) [20] applied several concentrations of 1-MCP on 'Rojo Brillante' persimmons and determined that 1-MCP concentrations had no effect on the weight loss. Koyuncu *et al.* (2005) [12] found the weight loss values belonging to control fruits of cv. 'Fuyu' as 0.48, 0.72 and 1.78% for 30, 60 and 90 days of storage, respectively. The results of Koyuncu *et al.* (2005) [12] were lower than those obtained in this study (30 days-2.80%, 60 days-4.68% and 90 days-7.49%).

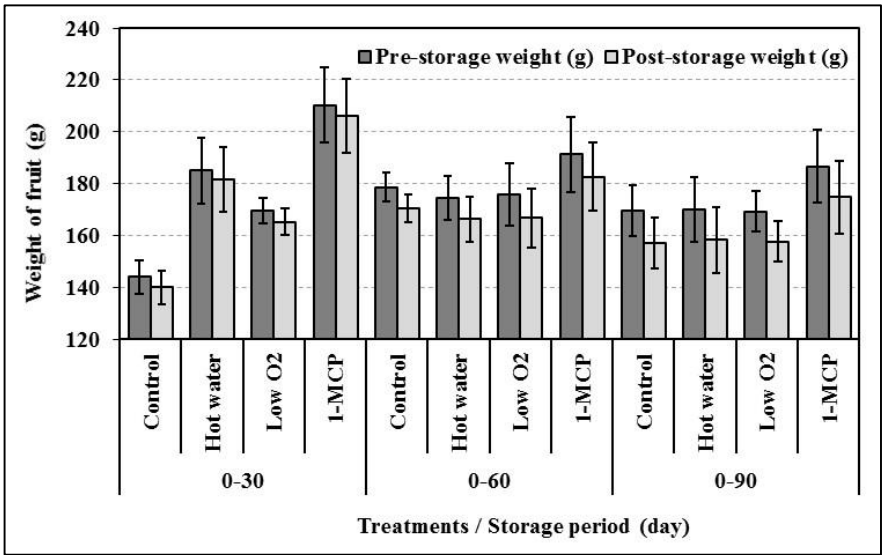

Fig 3: Weight values of the persimmons cv. 'Fuyu' during the storage period

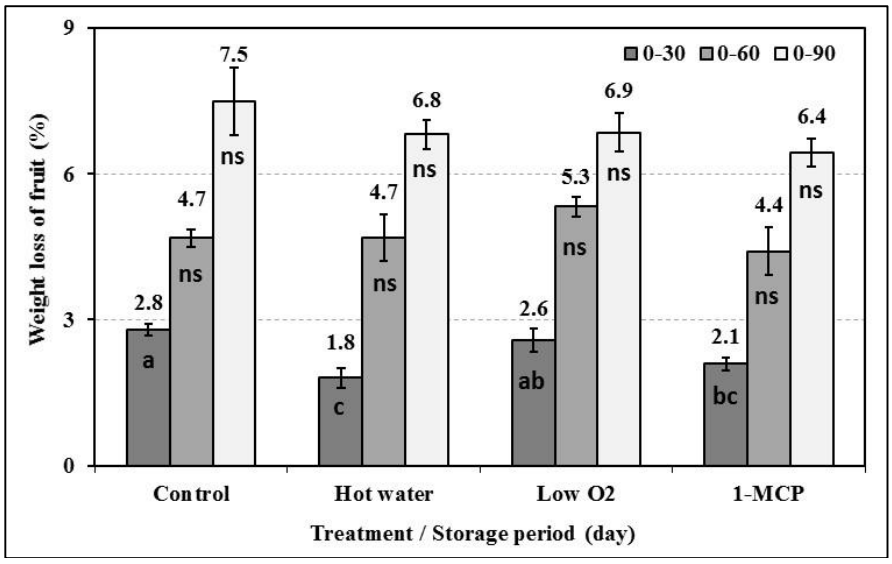

Fig 4: Differences in the weight loss values of the persimmons cv. 'Fuyu' during the storage period

Changes in bulk-fruit densities and porosity during storage

The average values of the bulk density and fruit density of the fruit were found to be between 560-600 kg/m^3 and 950-1060 kg/m^3, respectively. The bulk and fruit density results are similar to those reported by Altuntas *et al.* (2008) [2] for persimmons fruit cv. 'Fuyu', and cv. 'Hachia' fruit (Celik and Ercisli, 2008) [5]. The highest losses in the bulk and fruit densities depending on the storage period were determined in the fruits in hot water treatment and control (Table 3).

The porosity value calculated according to the bulk density and fruit density of the fruit varied between 41 and 45%, approximately (Fig 5.). The highest decreases in porosity depending on the storage period were determined in the fruits in control and hot water treatment groups. The porosity values were found in accordance with those reported by Altuntas *et al.* (2008) [2] and Koyuncu *et al.* (2005) [12] for 'Fuyu' cultivar, but the values were higher than those for cv. 'Hachia' fruit (Celik and Ercisli, 2008) [5].

Table 3: Bulk and fruit densities and changes in these parameters for the persimmons cv. 'Fuyu' subjected to different treatments and storage periods.

Storage period (day)	Treatment	Pre-storage bulk density (kg/m^3)	Post-storage bulk density (kg/m^3)	Change ratio in the bulk density (%)	Pre-storage fruit density (kg/m^3)	Post-storage fruit density (kg/m^3)	Change ratio in the fruit density (%)
0-30	Control	553.4±4.4	583.8±2.6	5.20±0.37	1018.8±4.3	1039.7±3.1	2.06±0.21
	Hot water	553.0±4.7	590.8±15.7	6.15±2.03	1001.9±10.2	1051.2±6.7	4.94±0.49
	Low O_2	571.9±2.4	586.2±2.5	2.44±0.22	987.9±2.3	1011.0±3.9	2.35±0.20
	1-MCP	567.9±2.8	596.3±5.5	4.74±0.46	989.8±2.0	1012.8±3.5	2.32±0.18
0-60	Control	529.7±11.2	568.8±9.3	6.85±1.74	990.4±1.5	1023.3±9.9	3.31±0.88
	Hot water	536.8±5.7	588.4±6.1	8.76±0.47	976.1±8.4	1028.0±8.6	5.32±0.21
	Low O_2	569.6±3.9	592.1±5.4	3.79±0.48	991.2±4.2	1023.1±4.8	3.22±0.28
	1-MCP	557.4±3.9	589.8±5.0	5.47±0.27	983.1±4.2	1020.8±11.7	3.83±0.87
0-90	Control	548.1±11.0	597.2±8.5	8.24±1.15	984.6±4.9	1050.6±10.3	6.70±0.56
	Hot water	541.7±9.6	606.7±9.9	10.71±0.74	952.6±21.7	1032.7±11.2	8.61±1.91
	Low O_2	554.3±4.8	585.9±4.8	5.40±0.16	981.7±7.1	1029.5±6.1	4.87±0.25
	1-MCP	544.1±6.0	582.0±5.8	6.51±0.41	963.3±5.6	1013.1±7.7	5.17±0.31

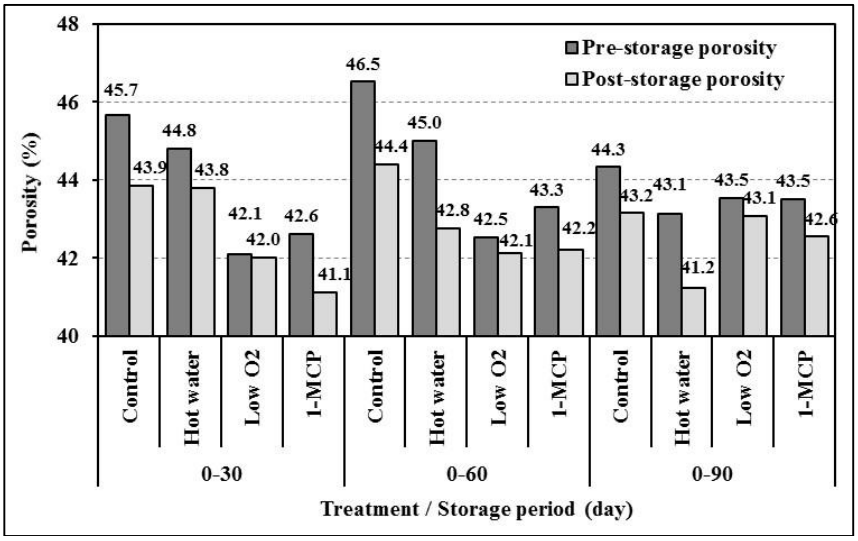

Fig 5: Changes in the porosity of the persimmons cv. 'Fuyu' during the storage period

Changes in total soluble solids during storage

The amount of total soluble solids (TSS), which has started to increase with the ripening of persimmons, is an important parameter for the determination of the eating quality of fruits (Wright and Kader, 1997) [24]. In the analyses carried out during the storage period, changes occurred in the amounts of soluble solids of the fruit were found statistically significant (Table 4). The values of the amounts of soluble solids of the fruit varied between 10-15%, however no linear increase or decrease was detected during the storage period. The value of TSS which was obtained from the fruits subjected to hot water treatment was found to be slightly lower than the other treatments. These fluctuations that occurred in the amounts of soluble solids during the storage period are in accordance with the results of the study conducted by Kuzucu and Kaynas (2002) [13]. Also, Demoura *et al.* (1997) [8] detected decreases in the TSS values of the fruits in the study they carried out on 'Taubate' persimmons.

Changes in fruit flesh firmness during storage

Fruit flesh firmness (FFF) is a parameter detecting the ripening level linked to softening of the fruits. An overall decrease in FFF was determined in all treatments. When the values obtained at the beginning and during the storage are examined, the FFF of the fruits, which were applied low O_2 and 1-MCP, were found to be higher (Table 4). Özdemir *et al.* (2006) [19] reported that fruit firmness values decreased with the prolonging storage period. Likewise, in a different study carried out with 'Fuyu' cultivar, the fruit flesh browning was found to be higher in the control treatment after the fruits were kept at 2°C in a modified atmosphere for 3 months; and the fruits in the control group softened more quickly (Chae *et al.*, 2004) [6]. The flesh firmness values are within the same range as 50.03 N reported for cv. 'Fuyu' fruit Altuntas *et al.* (2008) [2], but lower than 59.4 N reported for cv. 'Hachia' fruit (Celik and Ercisli, 2008) [5].

Table 4: Changes in the total soluble solids, fruit flesh firmness and fruit skin colour in persimmons cv. 'Fuyu' during storage.

Storage period (day)	Treatment	TSS (%)	FFF (N)	Fruit skin colour		
				L	a	b
0	Control	10.33	50.50	46.41	1.62	24.90
30	Control	12.00 b	54.52 a	48.75 a	14.35 c	26.45 a
	Hot water	12.33 b	52.43 b	43.82 b	17.16 b	23.81 b
	Low O_2	13.17 ab	53.63 ab	47.66 a	17.13 b	26.08 a
	1-MCP	14.67 a	47.08 c	46.46 ab	23.88 a	25.28 ab
60	Control	11.83 b	39.53 bc	45.24 ab	20.58 ab	25.44 ab
	Hot water	12.67 ab	44.65 b	44.05 ab	12.67 bc	24.34 b

	Low O_2	13.17 a	54.27 a	44.31 ab	22.17 a	25.88 ab
	1-MCP	12.33 ab	52.05 a	48.17 a	14.47 b	26.64 a
90	Control	12.33 b	43.84 bc	65.64 a	12.44 bc	60.63 a
	Hot water	13.17 ab	40.92 c	60.27 ab	15.77 b	49.69 bc
	Low O_2	14.33 a	46.79 b	57.04 b	11.78 bc	46.52 c
	1-MCP	14.50 a	52.80 a	62.26 ab	24.73 a	55.04 b

Different letters in the same column indicate significant differences at $P < 0.05$ level.

Changes in fruit skin colour during storage

As a result of the fruit skin colour (FSC) measurements, fluctuations in terms of increases and decreases were detected in the '*L**' and 'a*' values of the fruits (Table 4 and Fig 6.). In the study, it was detected that the colours of the fruits changed from green-orange to orange during the storage period. When the colour measurements were evaluated at the end of the storage period, the closest results to the initial '*L**' and '*a**' values were found with the fruits that were applied low O_2 and hot water. When the '*b**' values of the fruits were examined in terms of their yellow colour content, the treatments with the lowest yellow colour values were detected in the fruits that were stored under low O_2 conditions (Table 4). Altuntas *et al.* (2011) [3] reported '*L**', '*a**' and '*b**' values for persimmons fruit cv. 'Fuyu' as 91.80, 39.84 and 89.33, respectively, which were higher than those obtained in this study. In comparison with the other cultivars of persimmons, the colour values were also higher than those of cv. 'Hachia' fruit (Celik and Ercisli, 2008) [5].

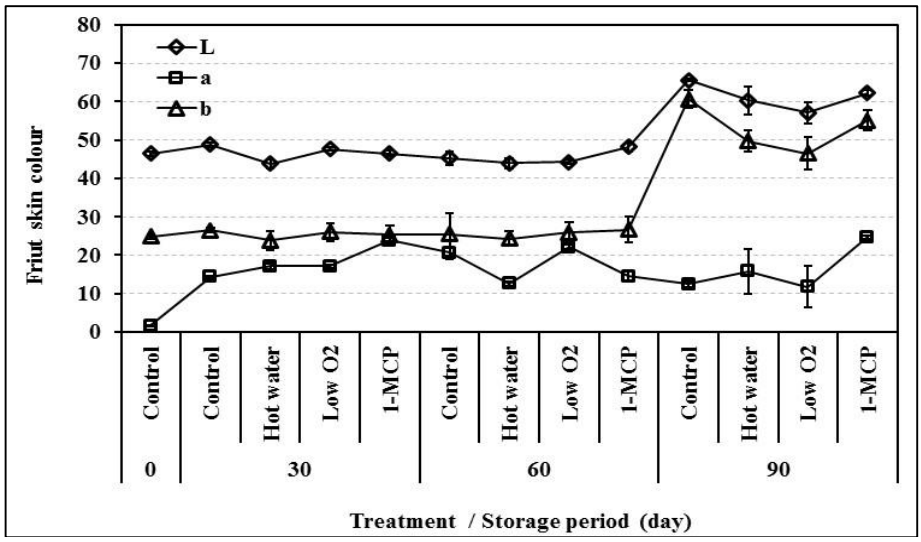

Fig 6: Changes in the fruit skin colour of the persimmons cv. 'Fuyu' during the storage period

Conclusion

Changes in the physical characteristics of persimmons cv. 'Fuyu' fruits subjected to hot water, low O_2, 1-MCP and control treatments before storage, along 30, 60, or 90 day-storage periods are summarized below:

- Reductions in the two axial dimensions (length and diameter) of cv. 'Fuyu' fruits at the end of 90 day-storage were found more pronounced in the control and hot water treatments, compared with the others.
- The lowest reduction in the projected area of was determined with the fruits in 1-MCP treatment group (0.6 and 3.3% on the 30th and 40th days, respectively).
- The treatments which resulted in the highest weight loss from the fruits were control and low O_2 treatment, whereas the lowest weight loss was noted in the hot water treatment.
- The highest losses in the mean bulk density and fruit density values were determined in the hot water treatment and control, while it was found lowest in the low O_2-applied fruits.
- TSS value of persimmons fruit was found lower in the hot water applied fruits compared with the other treatments, although significant changes could not be observed with this parameter along the storage period.
- An overall reduction was observed in FFF values of persimmons cv. 'Fuyu' fruits on the 60th and 90th days of storage; however FFF values of fruits belonging to O_2 and 1-MCP treatments were found higher than the fruits in the other treatments.
- A colour conversion from green-orange to orange was observed in the fruits along the storage period, the treatment resulted in the lowest yellow colour content was determined as low O_2 treatment.
- Considering all parameters, low O_2 treatment was determined to give the best result accompanied with the least loss. On the other hand, it was observed in the TSS, FFF and colour measurements of fruits that the hot water treatment could be more suitable with respect to the storability of fruit, in terms of duration and quality.

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