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Research Article

Effect of Different Regional Climates on Persimmon Quality

Abstract

Persimmon (*Diospyros kaki*) is grown in wide climate conditions, which may affect fruit biochemical characteristics such as vitamins, soluble solids and antioxidants. Therefore, the aim of this research is to evaluate the biochemical responses of fruit to these climate variables. For this purpose 5 districts of Kashan, Shahrud, Yazd, Kiasar and Sari were chosen to collect fruits. On November 2012, based on a complete block design ripen fruits were collected and quality factors were measured. The results of this research showed that local climate condition significantly ($P < 0.01$) influenced fruit biochemical characteristics. Fruit collected from Kashan had the highest vitamin C (1.74 mg /100 ml) acidity (pH = 6.6), while the samples from Shahrud had the highest soluble solids (22.13) and titratable acidity (0.04 mg/100 ml). Fruits collected from Yazd showed significant differences in Chl- and *carotenoids* contents, 0.07 and 0.42 mg/g, respectively, relative to other sites. These results show that arid and semi-arid districts enhance fruit quality.

Introduction

Persimmon *(Diospyros kaki)* belongs to the family *Ebenaceae* is widely grown in the climatic zones range in the world. This species is native to Japan and has wide leaves and delicious fruit. Planting this tree, because its fruits, first developed in Western countries and in the first decade of the 19th century was introduced to California and Southern Europe [1], and later entered Iran. And has also in many parts of the country expanded. In color, the ripe fruit of the cultivated strains range from light yellow-orange to dark red-orange depending on the species and variety. The fruit has a high tannin content which makes the immature fruit astringent and bitter. It is edible in its crisp firm state, but has its best flavor when allowed to rest and soften slightly after harvest [2].

Fruit harvested at different times have a significant impact on fruit quality characteristics [3-5]. Harvest index, based on experience and ecological conditions of climate zones evaluated at the end of December is completed. Harvest index, based on experience and ecological conditions of climate zones is complete at the end of December. Fruit picked before ripening to increase during storage and maintaining quality characteristics it is very important. Fruits that are harvested too early, smaller and color, aroma and taste them down [6,7].

The plant growth is influenced by genetic and environmental characteristics, so it could be more due to the differences in a variety of environmental factors to genetic changes. Thus, the lack of environmental factors, plant growth will be disorder and will stop [8]. Temperature is one of the factors affecting photosynthesis and plant metabolism at the cellular level. Seasonal and diurnal temperature changes has a significant effect on plant growth [9].

The difference in the temperature range can be attributed to variations in latitude, topography, proximity to large bodies of water represented. This constructive climate, due to the high heat capacity of water, this constructive climate, due to the high heat capacity of water, as evident in annual and the diurnal temperature range (DTR). Generally, higher temperatures lead to an increase in the rates of sugar accumulation in the fruit ripening and organic acids degardation, while low temperatures can lead to a reduction in the organic acids degradation and rates of sugar accumulation [10]. According to the daily temperature range, grape quality varies during the ripening period, because this parameter affects the sugar, anthocyanin compounds and as well as the aroma. During the day, photosynthesis occurs and at night photosynthesis product move from the source leaves to the fruit. Cool night temperature in during grape ripening favor the sugar accumulation and restrict the vegetative growth [11], Mori et al. [12], reported that at higher temperatures from 10˚C respiratory activity increases exponentially.

Persimmon fruit is rich in the carbohydrates, organic acids, vitamins (especially A and C), minerals, phenolic compounds and carotenoids [13,14]. Phenolic compounds with ascorbic acid protects the body against oxidative stress [15,16]. The amount of ascorbic acid (vitamin C) is a basic indicator to define the marketability of fruit and vegetables [17]. It is believed that vitamin C acts as an intermediate in the biosynthesis and metabolism of substances that are involved in the immune system [18]. Ebrahimzadeh et al. [19], reported a significant difference among citrus species for vitamin C contents. Therefore, the aim of this study was to investigate the effects of different climate zones, as a manifestation of changes in temperature and humidity, is the persimmon fruit quality.

Material and Methods

Climate regions features

In order to evaluate the effect of different climatic conditions on biochemical properties of persimmon fruit, from five areas (cities) with different climatic conditions, including: Sari (36.56° N, 53.06° E), Yazd (31.89° N, 54.36° E), Kiasar (36.23° N, 53.54° E), Kashan (33.98° N, 51.47° E) and Shahrud (36.41° N, 54.97°E) were sampled. Characteristics and geographical areas listed in Table 1.

Meteorological data

Daily data of maximum temperature, minimum temperature, average temperature and average relative humidity (During the growing season in 2014) of Iran Meteorological Organization (IMO) were received. Annual average calculated in Table 2 were reported. The difference between the dailymaximum and minimum temperature, the diurnal temperature range (DTR) was calculated.

$$DTR_{(^{\circ}C)} = T_{max} - T_{min} \quad (1)$$

Fruits

In this study, based on a randomized complete block design with three replications, from trees that have the same morphological characteristics, such as height, age and canopy, were sampled. To harvest fruit, the color index similar to citrus fruit (orange light-orange) was used.

Measuring of biochemical characteristics of fruit

To measure vitamin C from 2,6-Dichloroindophenoltitration method was used and the amount of vitamin C was calculated from the following equation [20].

$$Vit_{(c)}(\frac{mg}{100}) = \frac{e*d*b}{c*a} \times 100$$

Total soluble solid (TSS) in the juice was determined with a hand- refract meter (PR-32 palette, Atago Co., Japan) at room temperature and expressed as a Percentage [21]. Titratable acidity (TA) was determined in the presence of phenolphthalein (pH=8.2) and expressed as citric acid percent (Rabiei, 2006). pH of the juice was measured using a pH meter (Jenway,3020).To determine the amount of chlorophyll and carotenoid, first 0.5 g of sample was pulverized in the presence of 10 ml acetone 80%. The solution was centrifuged for 5 min at 5000rpm. Using a spectrophotometer (UV-1800 PC), the absorption rate in wavelength of 480, 510, 645 and 663 nm was recorded. Acetone 80% was used as a blank spectrophotometry [22]. The following formula for the amount of chlorophyll a, b, a * b and carotenoid were calculated:

Fruit biochemical data were analyzed using ANOVA of SAS software (SAS 9.1), and the SNK post hoc test was employed to compare treatment means.

$$Chloa(mg/\ g.f.w) = 12.7(A663) - 2.69(A645) * \frac{V}{1000} * W$$

$$Chlob(mg/\ g.f.w) = 12.9(A645) - 2.69(A663) * \frac{V}{1000} * W$$

$$Chloa \times b(mg/\ g.f.w) = 20.2(A645) - 8.02(A6663) * \frac{V}{1000} * W$$

$$Car(mg/\ g.f.w) = 7.6(A480) - 1.49(A510) * \frac{V}{1000} * W$$

Result and Discussion

Vitamin C (ascorbic acid) content

Different climatic conditions in the regions studied, very significant effect on the amount of ascorbic acid ($P \leq 0.01$). Based on research findings, fruits that were harvested from the areas of climate Yazd and Kashan, total vitamin C contentmore than the fruits that were harvested from other parts of the climate (Table 2).

According to Table 2, the highest vitamin C content of the fruit

Table 1: Geographical location and climatic characteristics of the regions studied.

Regional climate	Longitude (°E)	Latitude (°N)	*AMSL (m)	**temperature (°C)	**precipitation (mm)	The number of frost day
Sari	53.06°	36.56°	132	15	789.2	11
Shahrud	54.97°	36.41°	1130	12	375	98
Kashan	51.47°	33.98°	1570	18	116	65
Kiasar	53.54°	36.23°	1378	13	656	51
Yazd	54.36°	31.89°	1230	20.2	62	55

*The term above mean sea level (AMSL) is the elevation or altitude of any object, relative to the average sea level.
** Average of annual temperature and precipitation.

Table 2: Vitamin C, chlorophyll a, b and ab activity and carotenoid content of fruit harvested in different regional climate, during growth of persimmon fruit in 2012.

Regional climate	Vitamin **(mg/100ml)	Chlorophyll a ***(mg/g.f.w)	Chlorophyll b (mg/g.f.w)	Chlorophyll ab (mg/g.f.w)	Carotenoid (mg/g.f.w)
Sari	0.75c*	0.05a	0.03a	0.04a	0.22b
Shahrud	1.43b	0.01b	0.02a	0.03a	0.19b
Kashan	1.63a	0.01b	0.02a	0.03a	0.24b
Kiasar	1.40b	0.01b	0.02a	0.03a	0.19b
Yazd	1.74a	0.06a	0.03a	0.04a	0.42a

**Mg of fruit weight per the 100 ml fruit juice.
***Mg of fruit weight per the gram fruit fresh weight.
*means along different treatment on last column that carry the same letter have no significance difference (5%).

harvested from Yazd and Kashan climate regions, respectively, with values of 74.1 and 63.1 (mg/100 ml of fruit juice) and the lowest level was in sari climate region (76.0 mg/100ml of fruit juice). Many actions and reactions that occur in plants, each to be affected by temperature fall. The role of temperature on photosynthesis and respiration reactions can be noted among. The net value of the daily work of photosynthesis by plants and accumulated difference between the amount of carbohydrate that is made during the day and the amount of carbohydrate per day (24 hours) consumed by respiration. Plant for biological activity and construction, only products that is added daily during the photosynthesis process, it can consume or store it in an organ or other plant organs accumulated. However, it was found that when the total daily respiration is more than the daily photosynthesis, the plant products that already had accumulated storage consumes, if the trend continues, with a lack of food plants will be lost. With increasing temperature, respiratory rate becomes faster than the rate of photosynthesis, and the pure substance that is made daily by the plant reduced. The process of photosynthesis is limited to circumstances where there is enough light during the day, while the respiration process continues over a day (every hour of the day) the night temperature?? Has an important influence IIe on the pure substance that is made daily as a result of photosynthesis in plants. By breathing at 25°C, more food is consumed than 15°C [23].

Thus, areas with relatively cool nights and warm days are the pure substance stored in the plant and the yield will increase. On the contrary, in areas that are relatively warm nights of the pure substance stored and the yield is generally low. Based on the findings of the report could be said that in areas where the temperature difference between day and night was higher than other regions, have increased the amount of material stored and also had a higher qualitative characteristics. Therefore, it is believed that the reason for the higher rate of vitamin C fruits harvested from climatic regions of Kashan, Yazd, and shahrud than the Kiasar and Sari climate is the temperature Hamedani et al. [24]. Temperature difference between day and night for them. Hamedani et al. [24], Showed that the amount of vitamin C content in the orange fruit is affected by the temperature and the amount varied at different temperatures.

Chlorophyll and carotenoid contents of fruit

Determining the chlorophyll a and b and ab activity fruits harvested from different climatic regions showed that the climatic conditions of the region had a significant effect on the chlorophyll a activity ($P \leq 0.01$). While climatic conditions of the regions studied the activity of chlorophyll b and ab fruit had no significant effect (Figure 1). Results showed that the chlorophyll a activity affected by regional climate. As fruits that were harvested from the region of Yazd, highest of the chlorophyll a activity, compared with other parts of the climate. While, the amount of activity chlorophylls b and ab in different climatic conditions studied did not change. Also, different climatic conditions have a significant effect on fruit carotenoids content ($P \leq 0.01$). Based on the results, the carotenoid content of fruits that harvested from the region of Yazd, a higher rate than other parts of the climate (Figure 1).

In the early season vegetative growth to reproductive parts (fruits) more. Therefore, many materials are synthesized by the leaves of the vegetative organs stores; but with the growth of fruit photosynthetic products in the fruit stored [25]. Therefore, the amount of chlorophyll in fruit during ripening is reduced (Fattahi moghaddam 2010). As the fruits exposed to higher and lower temperatures than optimal, the fruit quality decreases. Perveen et al. [26], showed at temperatures close to zero and less than zero, the amount of chlorophyll a, b and carotenoid content in wheat was zero temperature. Sharma et al. [27], reported that, at a temperature close to 30°C, chlorophyll and carotenoid content is highest than 45°C.

Acidity (pH), Titratable Acidity (TA) and Total Soluble Solid (TSS)

The results showed that the different climatic conditions had a significant effect on pH, TA and TSS of fruit ($P \leq 0.01$). Thus, the fruits harvested in the Kashan region with value 6.6 had the highest

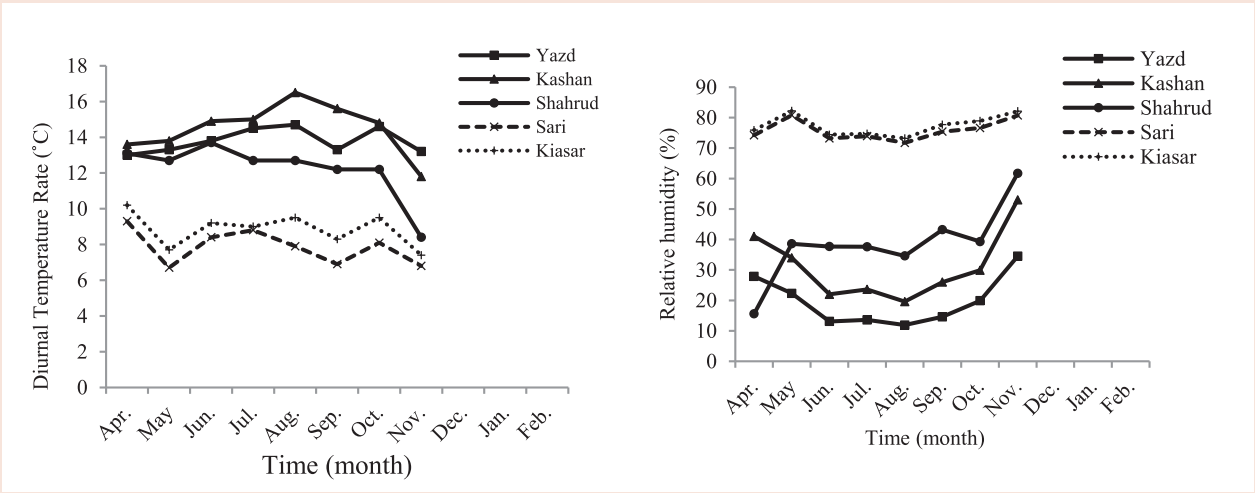

Figure 1: Diurnal Temperature Rate (DTR) (a) and Relative Humidity (b) changes, during growth of persimmon fruit in 2014.

Table 3: Acidity (pH), Titrable Acidity (TA) and Total Soluble Solid (TSS) of fruit harvested in different regional climate, during growth of persimmon fruit in 1392.

Regional climate	Acidity (pH)	Titratable acidity (TA%)	Total soluble solidity (TSS)
Sari	6.3b	0.01d	17.2c
Shahrud	6.3b	0.04a	20.1b
Kashan	6.6a	0.02c	22.3a
Kiasar	6.4b	0.02c	17.1c
Yazd	6.3b	0.03b	22.1a

Means along different treatment on last column that carry the same letter have no significance difference (5%).

pH while the highest TA and TSS (0.04 and 22.13 mg/100ml) was for the shahrud area, (Table 3). The physiological activity of fruit in many species with exposure to high and low temperatures reduced [28]. Fruit soluble solids content more dependent on the synthesis and transport of assimilates from the leaves to fruits [29]. Role of the high temperatures in transfer of the fruit, during fruit ripening is known [30]. As low night temperatures reduce the soluble solids content [31]. Therefore, it is believed that high levels of soluble solids content in Kashan and Yazd climates than the Kiasar and Sari climates, related to the higher the day and night temperature in these areas. Based on the results of Javanmardi and Kubota [32], by studying changes in quality of tomatoes grown in greenhouse conditions showed that, Approaching the peak temperature and solar radiation Fruit titratable acid content decreased with the increase in sugar. The results of this study, the results Khanal et al. [33], to increase the soluble solids content and titratable acid reduced the fruit under different temperature conditions confirmed.

Conclusion

Based on the finding, the effect of different regional climate on persimmon fruit quality were significant ($P \leq 0.01$).It is believed that, the day and night temperature changes on the amount of vitamin C, chlorophyll a, b and a, b activity and carotenoid content of harvested fruits was effective. Based on these findings, and considering the use of the properties of persimmon fruit in different sectors of agriculture, industry, medicine and nutrition, the importance of fruit quality should be taken into consideration more than ever.

References

1. Unal H (2004) Determination of Phenolic Compounds and Ascorbic Acid Content of Persimmon Fruit. MSc, Ankara University, Ankara, Turkey (in Turkish).
2. Baltaciglu H, Artik N (2013) Study of postharvest changes in the chemical composition of persimmon by HPLC. Turk J Agric. 37: 568-574.
3. Vielma MS, Matta FB, Silva JL (2008) optimal harvest time of various apple cultivars grown in Northern Mississippi. J American Pomological 62: 13.
4. Kviklienė N, Kviklys D, Lanauskas J, Uselis N (2008) Harvest time effect on quality changes of apple cultivar'Alva'during ripening and storage. Sodininkystėir Daržininkystė 27: 3-8.
5. Rizzolo A, Grassi M, Zerbini PE (2006) Influence of harvest date on ripening and volatile compounds in the scab-resistant apple cultivar'Golden Orange'. Journal of horticultural science & biotechnology 81: 681-690.
6. Juan JL, Frances J, Montesinos E, Camps F, Bonany J (1999) Effect of harvest date on quality and decay losses after cold storage of Golden Delicious apples in Girona. Acta Horticulturae 485: 195–201.
7. Zerbini PE, Pianezzola A, Grassi M (1999) Poststorage sensory profiles of fruit of five apple cultivars harvested at different maturity stages. I Food Qual 22: 1-17.
8. Ebrahimzadeh H (1990) Plant Physiology (2). University of Tehran Press 586.
9. Wahid A, Gelani S, Ashraf M, Foolad MR (2007) Heat tolerance in plants: An overview. Environmental and Experimental Botany 61: 199–223.
10. Seth D Cohen, Julie M Tarara, James A Kennedy (2011) Diurnal temperature range compression hastens berry development and modifies flavonoid partitioning in grapes. Am J Enol Vitic 63: 112-120.
11. Falcao LD, Burin VM, Sidinei Chaves E, Vieira HJ, Brighent E, et al. (2010) Vineyard Altitude and Mesoclimat Influences on The Phenology and Maturation of Cabernet-Sauvignon Grapes From Santa Catarina State. J Int Sci Vigne Vin 44 n°3: 135-150.
12. Mori K, Goto-Yamamoto N, Kitayama M, Hashizume K (2007) Effect of high temperature on anthocyanin composition and transcription of flavonoid hydroxylase genes in « Pinot noir » grapes (Vitisvinifera). J Hortic Sci Biotechnol 82: 199-206.
13. Veberic R, Jurhar J, Mikulic-Petkovsek M, Stampar F, Schmitzer V (2010) Comparative study of primary and secondary metabolites in 11 cultivars of persimmon fruit (Diospyros kaki L.) Food Chem 119: 477–483.
14. M Del Bubba, Giordani E, Pippucci L, Cincinelli A, Checchini L, Galvan P (2009) Changes in tannins, ascorbic acid and sugar contents in astringent persimmons during on-tree growth and ripening and in response to different postharvest treatments. J Food Compos Anal, 22: 668–677.
15. A Scalbert, G Williamson (2000) Dietary intake and bioavailability of polyphenols. J Nutr, 130: 2073S–2085S.
16. Suzuki T, Someya S, Hu Fm, Tanokura M (2005) Comparative study of catching compositions in five Japanese persimmons (Diospyros kaki). Food Chem 93: 149–152.
17. Siriporn O, Chadarat D, Songoyot A, Suganya T, Sombat C (2007) Comparison of antioxidant capacity and cytotoxicites of cartain fruit peels. Food Chem 103: 839-846.
18. Arya SP (2000) Non - spectrophotometric methods for the determination of vitamin-c. Analytical Chem Acta 417: 1-14.
19. Ebrahimzadeh MA, Hosseinimehr SJ, Gayekhloo MR (2004) Measuring and comparison of vitamin C content in citrus fruits: introduction of nativevariety. J Chem Indian J 1: 650-652.
20. Saini RS, Sharma KD, Dhankhar OP, Kaushik RA (2001) Laboratory Manual of Analytical Techniquesin in Horticulture. Agrobios Publisher 135p.
21. Piga A, D'Aquino S, Agabbio M, Emonti G, Farris GA (2000) Influence of storage temperature on shelf-life of minimally processed cactus pear fruits. LWT-Food Science and Technology 33: 15-20.
22. Raeini M, Shiukhy S (2014) Evaluation of the effect of geographical aspects and fruit location within orange tree canopy on Sangin orange fruit quality. J Agri Meteorol 2: 57-66.

23. Mozaffar A (1970) Plant physiology. College of Agriculture and Animal Husbandry Rezaieh Publication 665. (In Farsi).

24. Hamedani M, Rabiei V, Moradi H, Ghanbari A, Azimi MR (2012) Determination of storage duration and temperature effects on fruit quality parameters of blood orange (Citrus sinensis cv. Tarocco). Biharean Biologist 6: 10-13.

25. Ghasemi K, Ghasemi Y, Ebrahimzadeh MA (2009) Antioxidant activity, phenol and flavonoid contents of 13 citrus species peels and tissues. J pharm Sci 22: 277-281.

26. Perveen Salma, Shinwari Kamran Iqbal, Jan Mahamood (2013) Low Temperature Stress Induced Change in Biochemical Parameters, Protein Banding Pattern and Expression of Zat12 and Myb Genes in Rice Seedling. Journal of Stress Physiology & Biochemistry 9: 193-206.

27. Sharma R, Chahar OP, Bhatnagar M, Bhatnagar A (2013) Impact of osmotic stress and temperature on pigments and proteins of Anaboena strains. J Environ Biol 34: 941-943.

28. Zadeh Bagheri M, Kheradmand N, Sadeghi H, Nam Jahromi B (2010) Evaluation of the effect of temperature on amount of ethylene production & quantitative and qualitative characteristics apple fruit (Malusdomestica Borkh, cv. Granny Smith). Journal of Plant and Ecosystem 6: 33-44. (In Farsi).

29. Riga P, Anza M, Garbisu C (2008) Tomato Quality Is More Dependent on Temperature than on Photosynthetically Active Radiation. Journal of the Science of Food and Agriculture 88: 158-166.

30. De koning ANM (1989) The Effect of Temperature on Fruit Growth and Fruit Load of Tomato. Acta Horticulturae 248: 329-336.

31. Qi H, Hua L, Zhao L, Zhou L (2011) Carbohydrate Metabolism in Tomato (Lycopersicaon esculentum Mill.) Seedlings and Yield and Fruit Quality as Affected by Low Night Temperature and Subsequent Recovery. African Journal of Biotechnology 10: 5743- 5749.

32. Javanmardi J, Kubota C (2006) Variation of lycopene, antioxidant activity, total soluble solids and weight loss of tomato during postharvest storage. Postharvest Biology and Technology 41: 151-155.

33. Khanal B, Suthaparan A, Huckstadt AB, Wold AB, Mortensen L, et al. (2013) The Efffect of High Day and Low Night Temperature on Pollen Production, Pollen Germination and Postharvestv Quality of Tomatoes. American Journal of Plant Sciences 4: 19-25.

34. Mozaffari GH (2003) Principals of agricultural meteorology. Nikpendar Institute Publication 518. (In Farsi).

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