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Determination comparison of different some nut characteristics of pistachio (*Pistacia vera* L.) between Siirt and one Siirt select type

Ömer Faruk Bilgin[1]* **Şule Hilal Attar[1]** **Nesibe Ebru Kafkas[1]** **Salih Kafkas[1]**
[1]University of Çukurova, Faculty of Agriculture, Department of Horticulture, Adana, Turkey.
***Correspondence:** ofarukbilgin35@gmail.com

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Abstract

Larger nuts and kernels, high splitting rates, and high percentages of green kernel characteristics are desired and vital characteristics in pistachio breeding. Siirt variety (Pistacia vera L.) is a significant pistachio variety in Türkiye with good quality. We determined the new Siirt selection type has much better-quality nut characteristics than the Siirt variety. The aim of this study was to compare the differences between the Siirt selection type and the Siirt variety in terms of their nut characteristics such as 100-kernel weight, 100-nut weight, nut width (mm), nut height (mm), kernel width(mm), kernel height(m), chlorophyll a, and chlorophyll b, DPPH scavenging activity, total phenol, fatty acid contents, total lipid (%). Siirt variety hull had 1468 mg GAE/100 g, and the Siirt selection's hull also had 1291 mg GAE/100 g. Besides, the Siirt variety's kernel included 311.90, and the Siirt selection kernel contained 173.95 mg GAE/100 g. DPHH scavenging activity (%72.92-74.60) of pistachio hull was also higher than seed (%12.37-13.24) in Siirt variety and Siirt selection type. The total oil content in the samples studied was, on average, 58.63% (Siirt variety) and 52.03% (the Siirt Selection type). The primary fatty acids determined in both pistachio samples were oleic acid, which varied from 67.92 to 54.98%; linoleic acid, 23.16 to 34.93%; palmitic acid, which ranged from 9.68 to 8.82%. Siirt selection type had the highest weight nut (114.66 g per 100 dry shell nuts), while the Siirt variety has 107.63 g per 100 dry shell nuts) in the irrigated conditions. The Siirt variety and Siirt selection type had 53.54 % and 55.93 % (g kernel /100 g shell nut) under the irrigated conditions. As a result, the Siirt selection type can be promising new candidates for the pistachio plantation.

Key words

Siirt variety, Selection, Fatty acids, DPPH, Total Phenol

Introduction

Pistachio (Pistacia vera L.) is a member of the Anacardiaceae family and is among the most widely consumed tree nuts in the worldwide. Pistachio (Pistacia vera L.) is cultivated in dry regions of central and western Asia and spread all over the Mediterranean basin (Tomaino et al., 2010). Turkey is one of the most critical leading Pistachio (Pistacia vera L.) producing countries after the United States and Iran, with an annual output of 85,000 tons (FAO, 2020). Over the years, there have been instabilities in production quantity because of the alternate bearing phenomena of in pistachio cultivars cultivation or unfavorable climatic conditions, for instance, late spring frosts, and dry and hot winds (Kaska, 1994). The most significant production region of pistachio for Turkey is southeastern Anatolia including Gaziantep, Kahramanmaraş, Adıyaman, Şanlıurfa, Diyarbakır, Mardin, Siirt, Batman, and Şırnak provinces. The primary pistachio cultivars in the Southeast Anatolian region are Uzun, Kırmızı, and Halebi. Prolonged Among them nuts (mainly Uzun and Kırmızı) comprise most of the Tukey production. However, most these 2 pistachio cultivars show have alternate bearing strongly phenomena (Gündeşli et al., 2019; Kafkas et al., 2015) . Moreover, both cultivars Uzun and Kırmızı cultivars have come into bearing during the 8th year after budding. However, Siirt and Ohadi cultivars have earliness advantages, and which starts to bear just come in a few years (Ayfer et al., 1990). In addition, Siirt and Ohadi cultivars have highly splitting percentages, oval and large with kernel yellow. The long nuts are preferred throughout the industry for candy, ice- cream, and confectionary merchandise due to their special green kernel color, flavor, and texture (Balta et al., 2006; Gamli et al., 2007). The oval nuts are marketed can be consumed as snacks. The market prefers larger nuts with high splitting percentages like Ohadi, Siirt, and Kerman thanks to their excellent flavor. As a result, Siirt and Ohadi cultivars were recently used preferred by most growers in the area to plant new orchards. Looking at the requirements, internal and external markets, high-yielding cultivars with low alternate bearing ideals to get different types should be produced. Pistachio seeds nuts present a highly nutritive value due to their oil richness which differs from 45 to 63% on a dry-out weight basis their oil percentage and profile formula depends upon environmental factors such as climate, geography, and soil type… along with intrinsic factors such as variety (Agar et al., 1997; Garcia et al., 1994; Küçüköner et al., 2003; Satil et al., 2003; Yıldız et al., 1998a). The dietary properties of the pistachio nuts are mainly attributed to their richness of fatty acids (myristic, palmitic, margaric, stearic, elaidic, oleic, and linoleic acids), and chlorophylls (chlorophyll a and b) (Chaharbaghi et al., 2017). They contain a high antioxidant and anti-inflammatory potential due to their phytosterols, polyphenols, and tocopherols (Mokhtarian et al., 2017; Ojeda-Amador et al., 2018). According to reports, one of the most important cultivar properties in pistachio breeding is a tendency to alternate bear, and other desirable important characteristics of pistachio large nuts and kernels, high splitting rates, consistent bearings every year, and high percentages of the green kernel (Kaska, (1994) are desirable traits. Therefore, the pistachio market depends on the nuts and kernels' size, shape, color, and splitting percentage. Ferguson et al., (1995) reported that Kerman, which has an alternate bearing, is the major pistachio cultivar in California. Kaska, (1990) reported Siirt variety has lower alternate bearing traits than other pistachio varieties. Turkey has rather a rich pistachio population, and not more than enough selection studies related to attractive characteristics have been conducted. Tekin, (1995) mentioned that good pistachio selection types which has could have more excellent quality than any other pistachio cultivars. greater quality than any other pistachio cultivars.

Siirt variety is an important pistachio variety in Türkiye, preferred because of characterized by its good quality. The harvest period of the variety is usually starts from the beginning of September to the end of September. This study was conducted in Gaziantep province of Turkey. The aim of this study was to compare, the differences between new Siirt selection type and the Siirt variety in terms of nut characteristics were determined.

Material and Methods

Plant Materials

Siirt is one of the significant pistachio nut varieties that is commercially grown in Türkiye. Therefore, this cultivar was used in this study. This study used Siirt varieties grafted on Pistacia vera L. rootstock. The trees have been observed during the four years in the field of the farmer. However, only one year of result data was given in this study. The nuts were harvested from the farmer's orchard consisted of the Siirt variety located in Gaziantep provinces of Türkiye. One of the selected Siirt genotypes type was compared with the Siirt variety in terms of nut characterization and biochemical properties. The whole trees were applied to the same treatments such as irrigation, fertilization, chemical protection, and pruning.

Methods

The ripe pistachio fruits nuts (P. vera L., variety Siirt) were harvested in different directions on 15 September 2022 from the local farmer in Nizip

district at in Gaziantep, a city in the southeast of Turkey. The harvested samples were immediately transferred to the directly sent to the laboratory for analysis. All fruits of each cluster were mixed into one kilogram. Analyzes were performed on the samples of 2022. Nuts were cleaned manually to remove all foreign materials and broken nuts were discarded. Then Samples were exposed to an air convection oven drying at 65±4 °C until a constant weight was reached.

The following characteristic of nuts has been examined by using a digital caliper with a sensitivity of 0.01 mm (Mettler Toledo, ME54/M)

1.**The fruit size:** The number of nuts in 100 g of weight nuts without hulls was counted on three replicates

2.**100 fresh nut weight:** 100 fresh nut weight with hull was determined on four replicates.

3.**100 fry nut weight:** 100 nuts without hulls were dried and weight on three replicates.

4.**Percentage of kernel weight:** The kernel of 100 g of dry nuts with hull was excised, weighed, and the rate was in four replicates.

Three Characteristics of nuts for the selection of Siirt type have been used.

Chlorophylls Content

On kernels in both fresh and dry nuts, the chlorophyll contents were assessed. Four at random, twelve kernels were ground using a blender (Sterilmixer Pbi Brand), picked from each tree, and the purple tegument was removed. 0.20 g of powder was then added to 5 mL of N, N-Dimethylformamide (Agar et al., 1997). Aluminum foil-coated flasks were stored in the refrigerator at 5 C for 72 hours to prevent light deterioration of the pigments.

Whereas A647 absorbs at 647 nm while A664 does so at a distance of 664 nanometers using a Thermo Multi Scan Go spectrophotometer. Chlorophyll content was determined utilizing a spectrophotometer (Cary 50 Scan. Varian, Inc.) following Moran] computations (Equations (2)– (4)):

$$\text{Chlorophyll a} = 12.64 * A664 + 2.99 * A647 \quad (2)$$

$$\text{Chlorophyll b} = -5.6 * A664 + 23.26 * A647 \quad (3)$$

$$\text{Chlorophyll total} = 7.04 * A664 + 20.27 * A647 \quad (4)$$

Where A664 is the absorbance at 664 nm and A647 is the absorbance at 647 nm.

Total Phenolic Content

Folin-Ciocalteu reagent, as described by Slinkard et al., (1977), was used to colorimetrically determine total phenolics in the methanol solvent. Results were expressed as mg gallic acid equivalents per g dry weight using gallic acidity as a standard.

DPPH Scavenging Activity

The radical scavenging activity of DPPH (2, 2- Diphenyl a considerable 1-picrylhydrazyl) was performed as described by Ganhão et al., (2019) with slight modifications. Briefly, 0. 06 µM of ethanolic DPPH was freshly prepared. Then, 1950 µL of DPPH• was included with 50 µL liquid phase (After centrifuging the 70 percent methanol solution of crushed pistachio powder, it is extracted from the supernatant). The mixture is shaken for 1 min and kept at darkness for 30 minutes at room temperature. Absorbance is measured with the blank reagent by 515 nm. Radical scavenging process % DPPH inhibition was calculated working with the following equation:

$$\% \text{ Inhibition} = 100 \times [(\text{Abs blank}(t=30)) - (\text{Abs sample})] / [(\text{Abs blank}(t=30))] \quad (1)$$

in which Abs sample was the absorbance from the reaction in existence from sample (sample dilution+ DPPH solution),

(2) Abs blank was the absorbance of the blank for just about every sample dilution (sample dilution+ DPPH solvent), (3) and Abs control is the absorbance of control reaction (sample solvent+ DPPH solution).

Oil extraction:

They Nuts were dried and held at room temperature until analysis. The hard shells were crushed, and the inner skins were extracted before analysis. Unshelled pistachio nuts were ground to 0.5–0.8 mm in the commercial blender. Oil was extracted with petroleum ether (at 40–50°C) in a Soxhlet apparatus for four h. The solvent was released in a rotary vacuum evaporator.

Oil extraction yield

After the oil extraction, the oil extraction yield has been determined according to the weight of the oil from 100 g pistachio samples (Küçüköner et al., 2003).

Fatty acid determination

Agilent 7820A gas chromatography (GC) products having a flame ionization detecting (Agilent Technologies, Santa Clara, Florida, USA) performed a fatty acid analysis in the pistachio kernel. The oil samples obtained from the Soxhlet extraction were converted to the corresponding methyl ester sorts based on the method by (AOCS, 1993) with some changes by Ichihara et al., (1996). The column temperature program is 5 min at 1400C, 40C / min to 2000C, and 1 0C/ min to 2200C. The injector and detector temperatures were 220 and 2800C, respectively. The carrier gas was helium, the flow level was 0.3 ml/ day. Fatty acids were identified by simply comparing retention time with the standard mixture of methyl esters (Sigma- Aldrich Chemicals 189- 19) from butyric acid solution (C 4: 0) to nervonic acid (C 24: 1). The results were presented as % of total fat.

Results and Discussion

The current study compares the Siirt selection type's and the Siirt variety's seeds nuts and hull of pistachio nuts' composition and antioxidant properties. Fig 1 lists the antioxidant activity of pistachio seed and hull extracts as determined using the Folin-Ciocalteu reagent. Pistachio hull has consistently demonstrated significantly higher activity than their seeds, as predicted by the previous chemical analyses. Siirt variety hull had 1468 mg GAE/100 g, and the Siirt selection's hull also had 1291 mg GAE/100 g. Besides, the Siirt variety's kernel included 311.90, and the Siirt selection type's kernel contained 173.95 mg GAE/100 g. The other word, the Siirt variety had nearly two times more total phenol than the Siirt selection type. DPHH scavenging activity (%72.92-74.60) of pistachio hull found also higher than seed (%12.37-13.24) in both Siirt variety and Siirt selection type. Tsantili et al., (2011) studied that total phenolic and total antioxidant activity in different pistachio variety. The authors reported that total phenol, and DPPH ranged from 1620 to 790 mg gallic acid equiv. 100 g-1, and 122.6 to 45.7 umol Trolox equiv. g−1 d.w. Tomaino et al. (2010) found that phenolics reached the level of 1.65 and 116.32 mg GAE g−1 f.w in the seed and hull of fresh Bronte. Compared to Yang et al., (2009)'s findings, these results are lower, whole dry-roasted pistachio nuts in California. The chemical composition and biological characteristics of phytocomplexes are influenced by intrinsic and extrinsic factors, which must be mentioned to explain these various findings. Barreira et al., (2008) noticed significant variations in extracts' chemical composition and antioxidant power from several local almond cultivars concerning the intrinsic (genetic) factors. Besides, Gündeşli, (2020) stated that various pistachio tissues in 'on' and 'off' year trees are changed level of antioxidant activities and total phenolic contents.

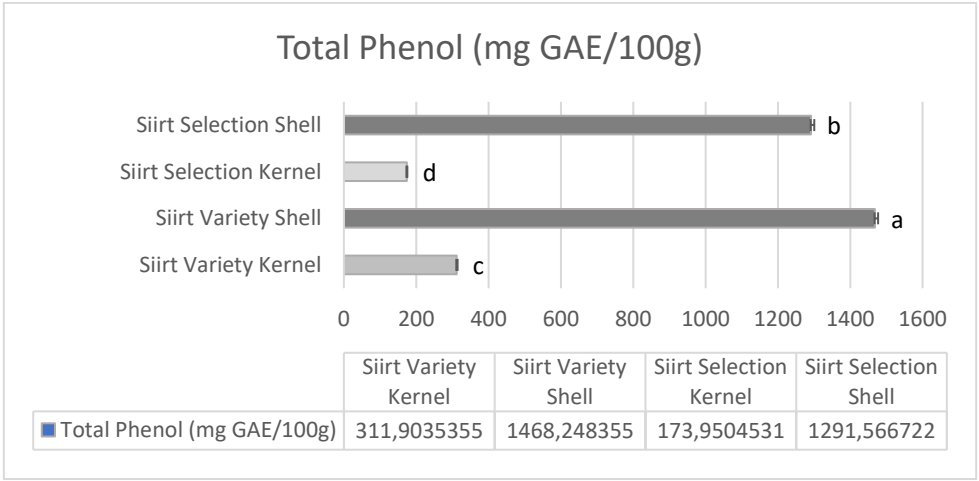

Figure 1. Total Phenol (mg GAE/ 100g) contents in Siirt variety and Siirt Selection Type. Each value is defined as mean ± standard error. Different letters indicate significant differences between the Siirt variety and Siirt Selection type in each column.

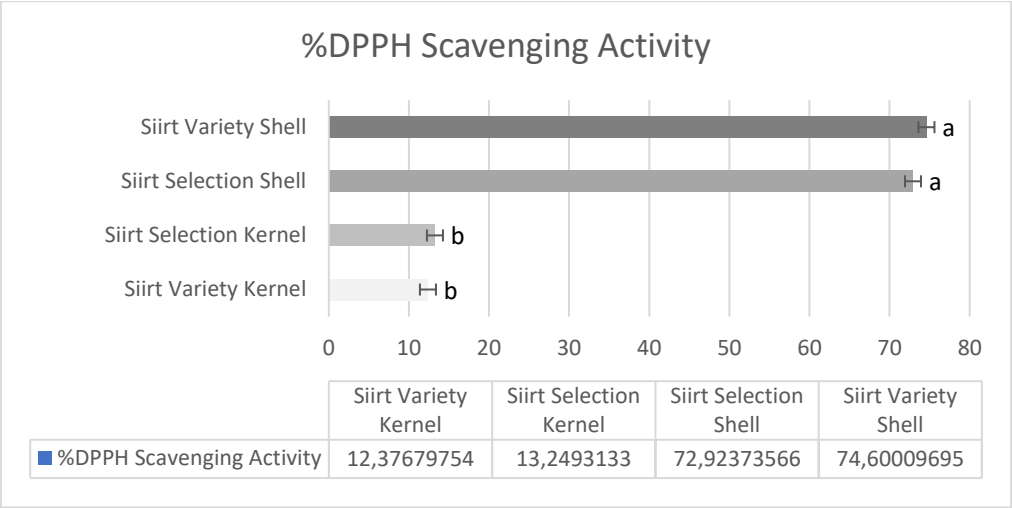

Figure 2. %DPPH Scavenging Activity contents in Siirt variety and Siirt Selection Type. Each value is defined as mean ± standard error. Different letters indicate significant differences between the Siirt variety and Siirt Selection Type in each column.

Table 1. Saturated fatty acids (SFA), Monounsaturated fatty acids (MUFA) and Polyunsaturated fatty acids (PUFA) of Siirt variety and Siirt Selection type

	SFA		MUFA	PUFA		
	Myristic acid	Palmitic acid	Oleic acid	linoleic acid	alfa linoleic Acid	Total lipid (%)
Siirt	0.11±0.020**b**	8.82±1.15**b**	67.92±9.58**a**	23.16±7.3**b**	0±0.00**b**	58.63±4.93**a**
Siirt Selection	0.12±0.003**a**	9.68±0.56**a**	54.98±10.4**b**	34.93±6.45**a**	0.28±0.04**a**	52.03±4.35**b**

Pistachios are a good source of fatty acids essential for human nutrition. It contains saturated, monounsaturated, and polyunsaturated fatty acids. Also, saturated fatty acids constitute <10% of our study's whole pistachios' fatty acids. The characteristics of Siirt variety and Siirt new selection oils were given in Tab. 1. The total oil content in the samples studied were on the average around 58.63% (Siirt variety) - 52.03% (Siirt Selection). Regarding the total fat ratio, the differences between samples have been found statistically important. In generally, total fat values determined in the cultivars are compatible with the findings of other researchers (Kafkas et al., 1995; Küçüköner & Yurt, 2003; Shokraii, 1977; Yıldız et al., 1998). On the other hand, Ouni et al., (2022) found that Kernel fat content of pistachio samples changed from 45.25% to 42.92%. This may be attributed to the effect of using pistachio variety. The monounsaturated fatty acids determined of both pistachio samples were, oleic acid varied from 67.92 to 54.98%, had similarly percentages as previously found in 67.62-70.41% (Ouni et al., 2022), in 70.1-71.5% (Tsantili et al., 2011) , in 53.16-72.63% (Agar et al., 1998), 51.8-71.23% (Abdoshahi et al., 2011), and 56.35-61.90% (Boualem et al., 2022) .Polyunsaturated fatty acids, linoleic acid varied from 23.16 to 34.93%, and linoleic acid changed from 0 to 0.28%. Similarly, results of linoleic acid contents were in agreement with those reported by Abdoshahi et al., (2011), Agar et al., (1998), Ouni et al., (2022), and (Boualem et al., 2022). Considering saturated fatty acids (SFA), Palmitic acid is varied from 9.68 to 8.82%, myristic acid is changed from 0.11 to 0.12%. In this study, palmitic acid is the main saturated fatty acid in both samples. Palmitic, oleic and linoleic acid have been identified as the predominant fatty acids in pistachio kernel oil in the literatures (Al-Bachir, 2015; Boualem et al., 2022; Fallah et al., 2018; Gecgel et al., 2011; Mexis et al., 2009). Linolenic acid was not found in any of the oil samples. This is of specially interest, considering that oleic and linoleic acid form the unsaturated fatty acids (88.91-91.08%) in these samples. Oleic acid is understood to be more stable against oxidative modifications than linoleic and linolenic acids, the higher level of oleic acid makes pistachio more stable for oxidation. In this study, no alfa-linolenic acid was detected in any of oil sample of the Siirt variety, while it was detected a low level in Siirt selection.

Table 2. Some nut properties of Siirt and Siirt Selection type nut grown under irrigated conditions.

	Weight of 100 dry shell nut (g)	Weight of dry 100 Kernel (g)	Nut Width (mm)	Nut Height (mm)	Kernel width (mm)	Kernel height (mm)	chlorophyll a	chlorophyll b
Siirt	107.63±6.45**b**	57.26±2.40**b**	11.38±1.08**b**	19.81±0.62	9.18±0.78**b**	17.33±0.02**a**	2.56±0.58**b**	4.62±0.57**b**
Siirt Selection	114.66±3.22**a**	64.13±1.32**a**	11.62±0.60**a**	19.79±0.82	9.58±0.1**a**	17.05±0.5**b**	3.65±0.68**a**	6.12±0.44**a**

Some properties of Siirt and Siirt Selection type nut grown under irrigated conditions were determined and the mean values± standart deviation were shown in the Table 2. 100-kernel weight, 100-nut weight, nut width (mm), nut height (mm), kernel width(mm), kernel height(m), chlorophyll a, and chlorophyll b were found statistically important ($p < 0.05$) between Siirt variety and Siirt Selection type. Kırmızı and Uzun cultivars have long nuts, have been significant cultivars in Turkey and are preferred by the people for their taste. However, two cultivars do not bear regular crops. According to the results of previous study by the Tekin, (1995) in Pistachio Research institute It indicated that cultivars with oval nuts have less tendency towards alternate bearing than those with long nuts. According to an international standard, there are three size groups for pistachio nuts: the First Group, which has 77 fewer nuts per 100 g of nuts, the Second Group (78– 88 nuts), and the Third Group (89– 109 nuts). The Siirt and Siirt Selection type fall into first Group. In our study, Siirt selection type had the highest weight nut (114.66 g per 100 dry shell nuts), while the Siirt variety has 107.63 g per 100 dry shell nuts) in the irrigated conditions. Besides, the Siirt variety and Siirt selection type had 53.54 % and 55.93 % (g kernel /100 g shell nut) in the irrigated conditions. Karaca et al., (1995) found reported that the Siirt variety had highest weight nut (132 g per 100 nuts) among domestic varieties, and kernel proportion (g kernel /100 g shell nut) of domestic and foreign varieties ranged from 43.04 to 42.90%. Parfitt et al., (2007) stated that Golden Hills had 1.32 g/nut (nut weight)- 0.66 cm3/nut (volume), and Kerman had 1.35 g/nut (nut weight), and 0.65 cm3/nut (volume). Another study was evaluated published concerning fruit in 6 promising genotypes of pistachio (Pistacia vera L.) and 11 varieties (Siirt, Kirmizi, Uzun, Sultani, Ketengomlek, Halebi, Ohadi, Kerman, Kaleh Ghochi, Ahmetaga, and Ekberi), and found that Nut nut characteristics of pistachios such as nut weight, kernel weight, and kernel percentage ranged 0.84 to 1.53 g, 0.50 to 0.82 g, and 42 to 70 %, respectively. The significant difference between the studies maybe is due to irrigated conditions, and different location. Pistachios are sold in different degrees of ripeness: green (unripe), yellow/green (medium ripe), or yellow (mature). Although color is

an essential parameter in the pistachio trade. As for the pigments of the pistachio, the first studies were carried out by Giovannini et al., (1958) in a paper on the metabolism of the chloroplast pigments of this fruit, which reported the presence of chlorophyll a, chlorophyll b; they also observed, during ripening, a first phase consisting in an accumulation of chlorophyll (August) followed by degradation (September). The color change from green to yellow green with maturation was also highlighted by Kunter et al., (1995) . The tested samples different two nut genotypes showed significant differences in clearly differentiation between chlorophylls a and b, which determine the blue-green and green-yellow colors of pistachio nuts. Siirt selection type had the highest chlorophyll a contents and chlorophyll b, being 3.65 and 6.12 mg/L. Agar et al., (1997) studied the variability of chlorophyll content in different pistachio varieties from several countries and found the highest chlorophyll content in pistachios from Italy. Bellomo et al., (2007) also gave similar results. These studies showed an evident influence of genotype on pistachio nuts' quality and sensory profile. The results of chlorophyll a contents and chlorophyll b in our study were higher than in literature (Bellomo et al., 2007; Agar et al., 1998). For all other samples with kernels of the same variety, such a comparison was difficult. These differences could be due to the different maturity of the nuts studied.

Conclusion

In the present study, quality parameters of nuts in Siirt variety were compared to one Siirt selection and taking everything into the consideration. One Siirt selection has better nut quality than the Siirt variety. Pistachio kernel oil was taken from the Siirt variety, and one Siirt Selection was analyzed for its composition. The outcomes demonstrated that the oil compositions of the two samples differ genotypes were differed. The information gathered may be helpful in terms of technology and nutrition. The information presented in this study may be helpful and useful for the establishment of international standards like Codex standards because it is not widely known pistachio kernel is made up of fatty acids, nuts, antioxidant, total phenol content, and chlorophyll a and b content.

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Author's Contributions

The contribution of the authors is equal.

Conflict of Interest

The author(s) declare no conflict of interest for this study.

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