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Fat content and Fatty acid composition of some Pistachio genotypes (*Pistacia vera* L.) using GC system

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Abstract: The earch was carried out in the General Commission for Scientific Agricultural Research to determine the compounds existed in ten Syrian pistachio genotypes, 2 Turkish genotypes and one Iranian genotype (*Pistacia vera* L.). The amount and type of fatty acids were identified using GC system. According to the obtained results, the major monounsaturated fatty acid (MUFAs) was oleic acid (C18:1) of high content ranged from 66.097% in the Iranian genotype (Iran.1) to 82.022% in the Syrian genotype (Ash.2) in significant differences ($P<0.05$), While the major composition of polyunsaturated fatty acid was linoleic C18:2 (Omega-6) of a percentage ranged from 2.310% in Turk.1 genotype to 19.544 % in Turk.2 genotype. And the major saturated fatty acid (SFAs) was palmitic acid (C16:0) of a content ranged from 6.249% in the Syrian genotype Ash.2 to 18.065% in the Turkish genotype Turk.1 The ratio of unsaturated/saturated fatty acid was ranged from 4.536% in Turk.1 to 15.002% in Ash.2 genotype indicating a high nutritious value.
Keywords: MUFAs,PUFAs,pistachio genotypes, GC system.

Introduction:

Pistacia vera is native to north Afghanistan, northeast Iran and central Asian republics[1], and the main world producers countries of pistachio nuts are Iran, USA, Turkey and Syria[2]. Several investigators[3,4] have reported on genetic diversity of Syrian Pistachio cultivars. In Syria, pistachio is an increasingly nut crop, nevertheless pistachio cultivation still depend on very narrow genetic diversity; in spite of the existence of many genotypes related to different cultivars were evaluated but still marginally exploited[5]. The unsaturated fatty acids content of pistachio nut makes it a nutritional product, but also makes it more susceptible to auto-oxidation[6]. Thereby, nuts with more polyunsaturated fatty acids (PUFAs) do notstore as well, because these fatty acids are susceptible to oxidative alterations due to their multiple double bonds[7]. However, kernels with higher ratios of unsaturated/saturated fatty acids which containing higher amounts of monounsaturated fatty acids (MUFAs) as oleic and lower amounts of PUFAs as linoleic are more nutritious and can be stored for longer periods of time[8]. The quality of pistachio nuts is associated with fatty acids composition, mainly with percentage of oleic and linoleic acids[9], these factors are affected by plant genotype [10] and environmental variables especially temperature[11]. No published data on the pistachios cultivated in the Southern of Syria in the previous literature. The objective of this research was to describe differences in 13 *P. vera* genotypes as related to variability in fatty acids composition.

Sample preparation for extraction and GC injection:

The dry pistachio kernels of ten Syrian genotypes (Ash.1, Ash.2, Ash.3, Ash.4, Ash.5, Bat.1, Bat.2,

Ajam.1, Ajam.2, and Bead.1), one Iranian genotype (Iran.1) and two Turkish genotypes (Turk.1 and Turk.2) were milled according to the method of AOAC No.963/22, 28 [12]. After removing the solvent by evaporation at 60ºC, the oil content was estimated as a percentage through the expression of weight ratio of extracted oil sample to the initial sample weight[13]. Petroleum Ether as solvent and Potassium Methyl (2n) was used to transform the oil into their methyl esters in order to be analyzed by gas chromatography. 3 µl of the upper aqueous using Microliter™ Syringe was injected in the GC (unicam 610 series) equipped with a flame ionization detector (FID) and a packed glass column (10 DEGS 10%), and The carrier gas was N2 with a flow rate of 1.5 ml/min. flame and injector temperatures were 250º C and 220º C respectively, and the column temperature was 185º C. The fatty acids were identified by the retention time by comparing with standards, Pro-GC unicam software connected to the GC allowed peak areas to be estimated.

Data treatment:

Analysis of variation (one way ANOVA) was achieved using Gen Stat program to assess the significant differences at ($P<0.05$) based on a completely randomized design (CRD), and means compared by Duncan's Multiple Range Test (DMRT).

Results and Discussion:

Seed oil content and fatty acid compositions were estimated, the fatty acid composition presented particularly; saturated (palmatic, C16:0), monounsaturated (oleic, C18:1) and polyunsaturated (linoleic, C18:2) fatty acids.

Total oil content:

The total amount of oil according to nuts dry weight ranged from 49.68% in the Turkish genotype (Turk2) to 58.43% in the Syrian genotype (Ash.2) in significant differences based on dry matter percentage, Table (1). The amount of pistachio nuts oil in the Syrian genotypes ranged between 48.16- 58.43%. Within Syrian genotypes, the two genotypes Bat.1 and Ash.2 significantly had the highest value of oil content (57.81% and 58.43%, respectively), whilst the oil content of Ajami genotypes (Aiam.1 and Ajam.2) was 54.13% and 52.24% of significant differences between each other. The genotype Beadi.1 related to Syrian Beadi cultivar contained low oil percentage (50.78%) which was in significant with all studied genotypes except Turk.2 genotype (49.68%). The oil content in the Iranian genotype (Iran.1) was 55.56%, this value was in coincidence with the oil amount of three Iranian pistachio cultivars (54.93-55.40%)[14]. the total amounts of oil in Turkish genotypes Turk.1 and Turk.2 were 52.12% and 4.6% which were less than the amount of oil in four Turkish and one Iranian pistachio cultivars (55.85- 59.73%) [15], this differentiation may related to the genotypes prosperities and management processes.

Unsaturated fatty acids composition (MUFAs and PUFAs):

Oleic acid (lipid name; C18:1) was the major fatty acid of pistachio oil, this result is in accordance with many studies [16,17,18] and showing a similar composition with olive oil [19], Table (1). The highest percentage of monounsaturated fatty acid (oleic acid) was 82.022 % presented in the Syrian genotype Ash.2, while the lowest percentage was 66.097% in the Iranian genotype Iran.1. Similarly, high levels of MUFA was reported in the seeds oil of *Pistacia vera* L. from different origins (65.6-83%)[20]. Accordingly, the average of oleic acid content in Syrian genotypes was ranged from 72.585% in Ash.5 to 82.22% in Ash.2 genotype. The monounsaturated fatty acids (oleic acid) composition of the genotype Iran.1 was 66.097%, which significantly revealed the lowest percentage in parallel with all studied genotypes at 5% except of the genotype Turk.2.

Linoleic acid as polyunsaturated fatty acid (PUFAs, omega – 6) is essential nutrients[21]. The percentage of linoleic acid ranged in significant differences from 2.310% in one of Turkish genotypes (Turk.1) to 19.544 % in the second Turkish genotype (Turk.2). The linoleic acid percentage in the Syrian genotypes ranged between 9.972% and 15.963%, Whereas linoleic acid (omega-6) content In the Iranian genotype (Iran.1) was 18.184% referring that this genotype is nutritious, but also relatively sensitive to auto-oxidative alterations when stores for long period due to the instability of double carbon strands; the more double bonds, the greater the susceptibility[7]. The total percentage of all UFAs ranged from 81.935 to 93.745% within all studied genotypes, which was approximating to oil amount in four Turkish and one Iranian pistachio cultivars (88.71%) [22], whereas less amounts of fatty acid (unsaturated fatty acids oleic and linoleic) was existed of about (80%)[23]. The ratio of MUFAs/PUFAs of studied genotypes ranged between 3.558% in Turk.2 genotype to 34.470% in Turk.1,

indicating that the genotype Turk.1 is less nutritional genotype but more suitable for long storage due to the few quantity of PUFAs (linoleic acid)[6].

Saturated fatty acids composition (SFAs):

Saturated fatty acids are very stable, the SFAs palmitic acid (the major fatty acid of SFAs) percentage significantly ranged from 6.249% in the Syrian genotype (Ash.2) to 18.065% in the Turkish genotype (Turk.1). In the Iranian genotype the percentage of palmitic acid was approximately high 15.719%. Similar results of pistachio palmitic acid percentage (10%) were achieved[22].

The ratio of UFAs/SFAs ranged from 4.536% in Turk.1 to 15.002 in Ash.2 genotype reflecting a high nutritional value and high scalability for storage of Ash.2 genotype basically due to the MUFAs content which was significantly richer in the stable oleic fatty acid percentage (82.022%) in comparison with all other studied genotypes, which is a desirable trait of oil to be more thermal stability as assessment of thermal stability of oil samples clearly confirmed this fact[24]. The two Turkish genotypes significantly differed in SFAs, MUFAs and PUFAs in particular the content of the PUFAs linoleic acid which was only 2.310% in Turk.1 and 19.544% in Turk.2, therefore it is predicted that the Turkish genotype Turk.2 is also sensitive to auto-oxidation and reversion taste. In parallel with previous studies, no significant differences was reported of Turkish pistachio fatty acids except linoleic acid (21.95% – 26.24%)[15]. According to recent outcomes, to evaluate the fatty acids composition among Syrian, Iranian and Turkish oil; the Syrian oil comprised a higher percentage of MUFAs (oleic acid) 75.966%, followed by Turkish oil 74.5825%, whereas Iranian oil had the lowest ratio (66.097%). PUFAs (primely Linoleic acid) content in the Iranian oil amounted to 18.184%, while it was low in Syrian and Turkish oil (12.2549% and 10.927%, respectively). Saturated fatty acids (palmitic acid) were apically in Iranian and Turkish oil (15.719 and 14.4045%), whilst it was (11.744%) in the Syrian oil. Our implications suggested that the content of fatty acids in pistachio kernel varied by the effect of the genotype. In addition to variety prosperities, site and climate condition should be considerable factors of fatty acids composition in pistachio kernels resulting in diversity of pistachio cultivars, the fact which was confirmed by other studies[14,25].

Table 1: Fatty acid composition of pistachio genotypes (cultivated in Syria) identified by GC

genotype	Oil content	Oleic (MUFAs) C18:1 cis-9	Linoleic (PUFAs) C18:2 cis-9,12	Total of UFAs %	Ratio of MUFAs/PUFAs	Palmitic (SFAs) C16:0	Ratio of UFAs/SFAs
Ash.1	55.08 ^{BC}	74.817 ^{CDE}	9.972 ^{F}	84.789	7.503	15.210 ^{BC}	5.575
Ash.2	58.43 ^{A}	82.022 ^{A}	11.723 ^{EF}	93.745	6.997	6.249 ^{F}	15.002
Ash.3	54.01 ^{C}	79.069 ^{AB}	10.344 ^{F}	89.413	7.644	10.279 ^{E}	8.699
Ash.4	48.16 ^{G}	76.059 ^{BCDE}	13.286 ^{DEF}	89.345	5.725	10.640 ^{E}	8.397
Ash.5	55.76 ^{B}	72.585 ^{EF}	15.963 ^{ABD}	88.548	4.547	11.174 ^{DE}	7.924
Ajam.1	54.13 ^{C}	76.689 ^{BCD}	12.264 ^{DEF}	88.953	6.253	11.047 ^{DE}	8.052
Ajam.2	52.24 ^{D}	73.481 ^{DE}	12.720 ^{DEF}	86.201	5.777	13.766 ^{BC}	6.262
Bat.1	57.81 ^{A}	74.189 ^{CDE}	14.879 ^{BDE}	89.068	4.986	10.932 ^{DE}	8.147
Bat.2	56.18 ^{B}	77.923 ^{BC}	11.407 ^{EF}	89.33	6.831	10.670 ^{E}	8.372
Bead.1	50.78 ^{F}	75.814 ^{BCDE}	11.127 ^{EF}	86.941	6.814	13.059 ^{CD}	6.658
Iran.1	55.56 ^{B}	66.097 ^{G}	18.184 ^{AB}	84.281	3.635	15.719 ^{B}	5.362
Turk.1	52.12 ^{D}	79.625 ^{AB}	2.310 ^{G}	81.935	34.470	18.065 ^{A}	4.536
Turk.2	49.68 ^{F}	69.540 ^{FG}	19.544 ^{A}	89.084	3.558	10.744 ^{E}	8.292
LSD	**1.132**	**3.836**	**4.201**			**2.203**	

Means separation was done by Duncan Test at $p \leq 0.05$.

Conclusion

In conclusion, pistachio kernel oil extracted from all studied genotypes is a good source of fats, especially low concentration of saturated fatty acids (SFAs) and high of unsaturated fatty acids (UFAs) which have therapeutic and nutritious properties, in particular the Syrian genotype (Ash.2) where the ratio of UFAs amounted to 93.745%, indicating to a high nutritional value and a good storable genotype, which leads to the hypothesis that the fatty acid composition was widely affected by the genotype in addition to the origin of cultivation.

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