Black Sea Journal of Agriculture
doi: 10.47115/bsagriculture.1071618

Open Access Journal
e-ISSN: 2618 – 6578

Research Article
Volume 5 - Issue 3: 189-194 / July 2022

DETERMINATION OF SATURATED AND UNSATURATED FATTY ACIDS IN SECOND CROP SEASON PEANUT CULTIVATION IN THE EASTERN MEDITERRANEAN

Mustafa YILMAZ[1]*

[1]*Oil Seeds Research Institute, 80000, Osmaniye, Türkiye*

Abstract: In this study; the saturated and unsaturated fatty acid composition of 11 different peanut cultivars, Runner (Georgia Green) Virginia (NC-7, Masal, Halisbey, Wilson, Com, Brantley, Duzici-1) Spanish (Florispan, Nigeria-1), widely grown in the eastern Mediterranean Transition Zone were determined. The research was carried out for two years (2020 to 2021) under second crop season conditions in the trial areas of the Oil Seeds Research Institute. The experiment was set up in a randomized block design with 3 replications. In the research, palmitic acid, stearic acid, arachidonic acid, oleic acid, linoleic acid, oleic/linoleic ratio, iodin value, behenic acid, arachidic acid properties were investigated. The highest oleic acid ratio was obtained from Masal (79.71%), the highest palmitic acid from florispan (11.06%), and the highest linoleic acid (34.08%) from florispan. The behenic acid ratio was found between 2.51% (Wilson) and 3.14% (Georgia Green).

Keywords: *Arachis hypogea* L., Oleic acid, Linoleic acid, Palmitic acid, Behenic acid

***Corresponding author:** Oil Seeds Research Institute, 80000, Osmaniye, Türkiye
E mail: mustafayilmaz80@hotmail.com (M. YILMAZ)
Mustafa YILMAZ https://orcid.org/0000-0002-1816-0729

Received: February 15, 2022
Accepted: April 07, 2022
Published: July 01, 2022

Cite as: Yılmaz M. 2022. Determination of saturated and unsaturated fatty acids in second crop season peanut cultivation in the eastern Mediterranean. BSJ Agri, 5(3): 189-194.

1. Introduction

Peanut (*Arachis hypogaea* L.) is an annual plant from the Leguminosae family, with 2n=40 chromosomes (Hammons et al., 2016). Peanut, originating from South America and the eastern parts of the Andes, has a very large cultivation area due to its good adaptation to the tropical and subtropical regions of the World (Stalker, 2017; Xie et al., 2020).

With the advancing technology and industry, especially with the help of the oil industry, peanut production has increased and will continue to increase day by day. The nutrition requirement of people is a big problem in almost every part of the world. Today, more than 70% of the world's population does not have enough nutrition. The basic principle in the protection and maintenance of human health is adequate and balanced nutrition. Today's people need to provide a balanced diet by supplying 15% of total calories from protein, 25% from fat and 60% from carbohydrates (Tang et al., 2013; Mekdad et al., 2021).

The protein, which peanut seed conteins 20-30% has a very high ratio of exogen ratio essential amino acids and biological value of 49 (Yaşlı et al., 2020; Yılmaz and Çiftçi, 2021). In terms of nutritional value, peanut has higher quality protein compared to other plant proteins. The fact that many of the amino acids that make up the peanut proteins are easily digestible, that increase their nutritional value. Therefore, peanut seeds can be consumed as fresh or dry roasted in large quantities as a snack (Cheng et al., 2018).

Since peanut oil very stable in high temperatures, it is widely used as frying oil. Due to its higher stability, peanut oil is used for the preparation of biscuits, cakes, confectionery, margarine, and canned fish. Low-quality peanut oils, on the other hand, can be used for soap, fuel, etc. Peanut oil is also used as a raw material in many industries. In addition, 30% of peanut oil is mixed with diesel fuels and used as fuel in the operation of diesel engines (Matthäus and Musazcan Özcan, 2015).

Peanut oil is rich in unsatured fatty acids. In vegetable oils, the quality of the oil increases in parallel with the increase in the unsaturated fatty acid ratio. Unsaturated fatty acid/saturated fatty acid ratio in peanut is 4.6. The fact that it contains eight of the fatty acids that are very important in terms of nutrition (Palmitic, Stearic, Oleic, Linoleic, Arachidic, Eicoseonic, Behenic and Nervolic fatty acids) that increases the nutritional value of the oil, and the presence of traces of linolenic acid, which is an undesirable fatty acid, increases the quality of the oil. Peanut oil is superior to other vegetable oils in terms of taste and durability (Davis et al., 2016).

This study aimed to determine the saturated and unsaturated fatty acids ratio and oil quality of different peanut varieties grown in the Eastern Mediterranean region in the second crop season peanut condition.

2. Material and Methods

Peanuts varieties tested in the present study were Runner (Georgia Green) Virginia (NC-7-, Masal, Halisbey, Wilson, Çom, Brantley, Düzici-1) Spanish (Florispan, Nigeria-1) market types. The trial was established in as second crop season after wheat at Cevdetiye locations belonging to Osmaniye Oil Seeds Research Institute in 2020 (37°07'28" N, 36°11'38" E; 50 m) and 2021 (37°07'89" N, 36°11'33" E; 50 m).

Trials were set up as 3 replications according to the randomized blocks design. Each plot consisted of 4 rows of 5 m length with inter and intra row spacing of 70 and 15 cm, respectively. Each plot was 14 cm^2. Before planting 25 kg da^{-1} of DAP was applied. Before the first irrigation, 15 kg da^{-1} of urea was applied and 10 kg da^{-1} of urea was applied before the second irrigation. Irrigation was done 5 times during both growing seasons with the sprinkler system. Harvesting was done by hand, side effects were discarded, and harvest parameters were evaluated on ten randomly selected plants in the two mid-rows of plots. Harvest was done on September 15, 2020, and on September 25, 2021.

In Osmaniye, has the Mediterranean type of climate, with warm and rainy winters and hot and dry summers. Some important climatice parameters for long seasons and the climate parameters of growing years 2020 and 2021 were given in (Table 1).

As can be seen from the Table 1 that the total amount of precipitation in 2020 was lower than in 2021. It has been determined that the average temperature in 2020 was lower than 2021 and higher than the average of long season values. It has been determined that the average relative humidity of long seasons was lower than 2020 and higher than 2021.

Table 1. Climate parameters of the research field (2020, 2021, and long-year average)

Months	Precipitation (mm)			Temperature (°C)			Relative Humidity (%)		
	LY	2020	2021	LY	2020	2021	LY	2020	2021
April	86.5	123.9	32.3	17.0	17.1	17.7	64.2	69.4	64.8
May	72.6	83.5	4.6	21.3	22.1	22.9	63.2	62.4	59.8
June	42.4	5.5	1.8	25.2	24.0	25.0	62.7	68.7	65.9
July	19.8	2.0	15.7	27.9	28.4	28.9	66.4	71.7	64.6
August	10.7	21.5	19.7	28.6	28.6	29.3	64.9	64.0	62.8
September	34.5	0.9	14.0	25.7	28.6	25.9	60.7	61.8	60.8
Total/Av	266.5	237.3	88.0	24.3	24.8	25.0	63.7	66.3	63.1

Av= average; LY= long year.

Determination of fatty acids composition: Fatty acid methyl esters were prepared according to AOCS (1989), method Ce 2-66 and analyzed with HP 6890 Series II Gas Chromatograph (GC) (Hewlett-Packard Company), (Agilent Technologies, Wilmington, DE, USA) equipped with a flame ionization detector and autosampler. A fused silica capillary column SP 2340 (60 m × 0.25 mm i.d.) with a film thickness of 0.25 µm (Supelco, Taufkirchen, Germany) was used. Injection, detector, and oven temperatures were 250, 260, and 190°C, respectively. Nitrogen was used as a carrier gas at a flow rate of 1.0 mL min^{-1}. Individual peaks were identified by comparing the retention times with grain fatty acid methyl esters.

Iodine values (IV) = [(% oleic acid x 0.8601) + (% linoleic acid x 1.7321)] and Oleic acid/Linoleic acid (O/L) ratio = [% oleic acid (18:1)/linoleic acid (18:2)] of the peanut oils were calculated using the equation given by Chowdhury et al. (2015).

Experimental data were subjected to analysis of variance by RCBD separately for each year with the aid of R v4 software. Means were compared with the aid of Duncan's multiple range test (Genç and Soysal, 2018).

3. Results and Discussion

Arachidonic acid was statistically significant (P<0.01) between years and cultivars. Palmitic acid was statistically significant (P<0.01) between years and cultivars. Stearic acid was statistically significant (P<0.01) between years, cultivars, and year x cultivars interaction was significant. Oleic acid was statistically significant (P<0.01) between years and cultivars. Linoleic acid was statistically significant (P<0.01) between years and cultivars. It was determined that oleic/linoleic (O/L) acid was statistically significant (P<0.01) among cultivars. Behenic acid was statistically significant (P<0.01) between years and cultivars. Lingoseric was statistically significant (P<0.01) interactions between years, cultivars, and year x cultivars. Iodine value was statistically significant (P<0.01) between years, cultivars, and year x cultivars interaction were significant (Table 2).

According to a two-year data, the highest arachidic acid ratio was found in the Masal variety with 1.65, while the Florispan variety was found the least with 1.26% (Table 3). Salamatullah et al. (2021) reported that the arachidic acid ratio varied between 1.30-1.43%; Gölükçü et al (2016) reported that the arachidic acid value varied between 1.17% and 1.66%; Söğüt et al. (2016) determined that the ratio of arachidic acid varies between 0.102% - 0.123%. The difference in arachidonic acid was thought to be due to environmental factors and genotypic make-up of the cultivars.

Table 2. Results of the analysis of variance for characteristics studied in the experiment

SV	df	PA	SA	AA	OA	LA	IV	O/L	BA	LS
Block	4	ns	ns	ns	ns	ns	ns	ns	ns	Ns
Year	1	**	**	**	**	**	**	ns	**	**
Varieties	14	**	**	**	**	**	**	**	**	**
Y x V	14	ns	**	ns	ns	ns	**	ns	ns	**
CV (%)		4.43	4.20	4.98	2.43	4.50	1.41	22.25	5.03	5.74

SV= source of variation, df= degree of freedom, CV= coefficient of variation, PA= palmitic acid, SA= stearic acid, OA= oleic acid, LA= linoleic acid, O/L= oleic/linoleic ratio, IV= iodin value. **P<0.01.

Table 3. Means of palmitic acid, stearic acid and arachidonic acid

	Palmitic Acid (%)			Stearic Acid (%)			Arachidonic Acid (%)		
Varieties	2020	2021	Average	2020	2021	Average	2020	2021	Average
Nigeria-1	9.12 ^{cde}	9.80 ^{cde}	9.46 ^{cd}	3.29 ^{a}	3.86 ^{a}	3.58 ^{a}	1.48 ^{b}	1.55 ^{bcd}	1.52 ^{bc}
NC-7	9.27 ^{cd}	9.75 ^{cde}	9.51 ^{c}	3.07 ^{a}	3.13 ^{c}	3.10 ^{c}	1.60 ^{a}	1.57 ^{abc}	1.59 ^{ab}
Masal	5.05 g	5.95 ^{g}	5.05 ^{g}	3.19 ^{a}	3.66 ^{b}	3.42 ^{b}	1.61 ^{a}	1.69 ^{a}	1.65 ^{a}
Georgia Green	10.11 ^{ab}	11.02 ^{ab}	10.56 ^{b}	1.82 ^{e}	1.92 ^{g}	1.87 ^{h}	1.12 ^{d}	1.87 ^{f}	1.56 ^{g}
Halisbey	8.73 ^{de}	9.27 ^{e}	9.00 ^{de}	2.51 ^{bc}	2.61 ^{e}	2.56 ^{ef}	1.39 ^{bc}	1.41 ^{de}	1.40 ^{de}
Wilson	8.43 ^{e}	9.08 ^{e}	8.76 ^{e}	2.57 ^{b}	2.72 ^{de}	2.64 ^{de}	1.38 ^{bc}	1.42 ^{de}	1.39 ^{de}
Com	9.78 ^{bc}	10.43 ^{bc}	10.11 ^{b}	2.15 ^{d}	2.35 ^{f}	2.25 ^{g}	1.17 ^{d}	1.35 ^{e}	1.26 ^{f}
Sultan	8.67 ^{de}	9.56 ^{de}	9.12 ^{cde}	2.54 ^{bc}	2.62 ^{e}	2.58 ^{ef}	1.36 ^{bc}	1.45 ^{cde}	1.41 ^{de}
Brantley	7.19 ^{f}	7.99 ^{f}	7.59 ^{f}	3.07 ^{a}	3.18 ^{c}	3.13 ^{c}	1.43 ^{bc}	1.46 ^{cde}	1.45 ^{cd}
Florispan	10.60 ^{a}	11.52 ^{a}	11.06 ^{a}	2.41 ^{c}	2.58 ^{e}	2.50 ^{f}	1.33 ^{c}	1.31 ^{ef}	1.32 ^{ef}
Duzici-1	8.91 ^{de}	10.17 ^{cd}	9.54 ^{c}	2.68 ^{b}	2.83 ^{d}	2.76 ^{d}	1.42 ^{bc}	1.63 ^{ab}	1.53 ^{bc}
Average	8.71	9.50	9.07	2.66	2.86	2.76	1.39	1.52	1.46

$^{a-f}$Different letters shows statistical differences (P<0.05) in same column.

It was determined that the average palmitic acid ratio in the second crop peanuts varied between 5.05-11.06% (Table 3). Yu et al. (2020) reported that oleic and palmitic acid ratio were 2.92 and 5.5% respectively; Shibli et al. (2019) found that the palmitic acid ratio varied between 9.32-12.03%; Kamdar et al. (2021) reported palmitic acid values between 8.1-14.2%. Shibli et al. (2019) and Yu et al. (2020) reported that there was a linear relationship between the palmitic acid ratio and the average temperature from flowering to harvest. The palmitic acid in 2020 was lower than 2021. When we look at the climate values, it is seen that 2021 is warmer than 2020 (Table 1). Our findings were similar to the findings reported in the literature.

It was determined that the average stearic acid ratio varied between 1.87-3.58% (Table 3). Salamatullah et al. (2021) found that the rate of stearic acid varied between 4.01–4.59%; the amount of stearic acid in 2021 was higher than in 2020. As can be seen in Table 1 that the temperature in 2020 was lower than in 2021.

According to the two-year average values, the lowest oleic acid ratio was determined from cultivar Florispan (43.38%), and the highest was determined from Masal (79.71%) (Table 4). The rate of oleic acid in 2020 was lower than in 2021. Gali et al. (2021) and Asibuo et al. (2008) reported that the rate of oleic acid was 55.9% in peanut. Zhang et al. (2009) reported that the rate of oleic acid varied between 45.2-56.4%. Wang et al. (2013) determined that the rate of oleic acid varied between 38.97-62.04%. The oleic acid ratio in our study was similar to other studies.

Table 4. Means of oleic acid, linoleic acid

Varieties	Oleic Acid (%)			Linoleic Acid (%)		
	2020	2021	Average	2020	2021	Average
Nigeria-1	52.78 ^{d}	54.50 ^{d}	53.64 ^{de}	24.28 ^{d}	25.16 ^{d}	24.72 ^{d}
NC-7	56.76 ^{c}	57.56 ^{c}	57.16 ^{c}	21.46 ^{f}	22.38 ^{e}	21.92 ^{e}
Masal	79.39 ^{a}	80.03 ^{a}	79.71 ^{a}	2.24 ^{g}	2.45 ^{g}	2.34 ^{g}
Georgia Green	43.57 ^{g}	44.87 ^{g}	44.22 ^{h}	32.50 ^{a}	33.96 ^{a}	33.23 ^{a}
Halisbey	51.79 ^{d}	53.53 ^{d}	52.66 ^{e}	26.69 ^{c}	27.33 ^{c}	27.01 ^{c}
Wilson	53. 78 ^{d}	55.82 ^{cd}	54.80 ^{d}	24.35 ^{d}	25.08 ^{d}	24.72 ^{d}
Com	45.71 ^{f}	48.03 ^{f}	46.87 ^{g}	29.90 ^{b}	31.16 ^{b}	30.53 ^{b}
Sultan	48.65 ^{e}	50.79 ^{e}	49.72 ^{f}	27.92 ^{c}	28.55 ^{c}	28.24 ^{c}
Brantley	69.15 ^{b}	70.15 ^{b}	69.65 ^{b}	11.10 ^{f}	11.73 ^{f}	11.41 ^{f}
Florispan	42.39 ^{g}	44.36 ^{g}	43.38 ^{h}	33.66 ^{a}	34.50 ^{a}	34.08 ^{a}
Duzici-1	53.67 ^{d}	54.66 ^{d}	54.17 ^{de}	23.60 ^{d}	24.81 ^{d}	24.20 ^{d}
Average	51.91	53.60	52.76	25.24	26.15	25.69

$^{a-h}$Different letters shows statistical differences (P<0.05) in same column.

Mean linolenic acid ratios were between 2.34% (Masal) and 34.08 (Florispan) (Table 4). Gali et al. (2021) reported that the ratio of linoleic acid varied between 27.87-31.16% and there was a negative correlation between the percentage of oleic and linoleic acid. Bishi et al. (2015) reported that the ratio of linoleic acid varied between 22.4-41.4% and there was an inverse relationship between mean temperature and oleic and linoleic acid. The study is similar to other studies. According to two-year climate data, the monthly average temperature in 2021 was higher than in 2020, so the linoleic ratio was thought to be high in 2021 (Table 1).

The determined iodine value was between 72.62% (Masal) and 96.35% (Florispan) according to the two-year average data (Table 5).

It has been reported that the two-year average O/L value rate varied between 1.27% and 34.35% (Table 5). Gali et al. (2021), reported that O/L value rate varied between 1.20 and 27.52; Lopez et al. (2001) It has been determined that the O/L value rate varies between 0.8-2.5%. O/L values rate were similar to other studies.

Cultivar Wilson had lowest behenic acid rate with 2.51%, and Georgia Green was the highest with 3.14% in two years average data (Table 6). Shibli et al. (2019) reported that the ratio of behenic acid varied between 2.69-2.89%; Konuskan et al. (2019), reported that the ratio of behenic acid is 3.25%; Candela et al. (2019), the ratio of behenic acid is 5.82%; Akcura et al. (2021) determined that the ratio of behenic acid varied between 3.02-3.64%. Our study was performed by Shibli et al. (2019) and Akcura et al. (2021) similarity to the study; Konuskan et al. (2019) and Candela et al. (2019) differed with the studies conducted by. Akcura et al. (2021) reported that the fatty acid composition of peanut oil depends on the genotype, seed maturation, climatic conditions, the region where it is grown, and the interaction between these factors.

It was determined that the average lignoceric acid ratio for two years varied between 1.07% and 1.78% (Table 6). The amount of lignoceric acid varied between 1.01-1.88%; Konuskan et al. (2019), ligneceric 1.62%; Candela et al. (2020) reported that the rate of lignoceric acid varies between 1.0-1.86%. The ratio of behenic acid in the studies was similar to our study.

Table 5. Means of iodine value (IV), oleic/linoleic ratio (O/L)

	Iodin Value (IV)			Oleic/Linoleic Ratio (O/L)		
Varieties	2020	2021	Average	2020	2021	Average
Nigeria-1	87.45 ^{c}	90.46 ^{d}	88.96 ^{c}	2.18 ^{c}	2.17 ^{c}	2.17 ^{c}
NC-7	85.99 ^{c}	88.28 ^{e}	87.13 ^{d}	2.65 ^{c}	2.57 ^{c}	2.61 ^{c}
Masal	72.16 ^{f}	73.08 ^{g}	72.62 ^{f}	35.76 ^{a}	32.93 ^{a}	34.35 ^{a}
Georgia Green	93.77 ^{a}	97.41 ^{a}	95.59 ^{a}	1.34 ^{c}	1.32 ^{c}	1.33 ^{c}
Halisbey	90.77 ^{b}	93.38 ^{c}	92.08 ^{b}	1.94 ^{c}	1.97 ^{c}	1.96 ^{c}
Wilson	88.42 ^{bc}	91.45 ^{d}	89.94 ^{c}	2.22 ^{c}	2.24 ^{c}	2.23 ^{c}
Com	91.10 ^{b}	95.28 ^{b}	93.19 ^{b}	1.53 ^{c}	1.54 ^{c}	1.54 ^{c}
Sultan	90.21 ^{b}	93.13 ^{c}	91.67 ^{b}	1.74 ^{c}	1.78 ^{c}	1.76 ^{c}
Brantley	78.71 ^{d}	80.64 ^{f}	79.67 ^{e}	6.29 ^{b}	6.07 ^{b}	6.18 ^{b}
Florispan	94.78 ^{a}	97.92 ^{a}	96.35 ^{a}	1.26 ^{c}	1.28 ^{c}	1.27 ^{c}
Duzici-1	87.03 ^{c}	89.98 ^{d}	88.51 ^{cd}	2.28 ^{c}	2.21 ^{c}	2.42 ^{c}
Average	87.31	90.09	88.70	5.35	5.10	5.26

$^{a-f}$Different letters shows statistical differences (P<0.05) in same column.

Table 6. Means of behenic acid, lignoceric acid

	Behenic Acid (%)			Lignoceric Acid (%)		
Varieties	2020	2021	Average	2020	2021	Average
Nigeria-1	2.71 ^{b}	2.77 ^{b}	2.74 ^{b}	1.21 ^{f}	1.29 ^{c}	1.25 ^{c}
NC-7	2.56 ^{cd}	2.54 ^{c}	2.55 ^{d}	1.25 ^{ef}	1.54 ^{b}	1.39 ^{b}
Masal	2.65 ^{bc}	2.73 ^{bc}	2.69 ^{bc}	1.39 ^{bcd}	1.41 ^{bc}	1.40 ^{b}
Georgia Green	3.12 ^{a}	3.17 ^{a}	3.14 ^{a}	1.76 ^{a}	1.80 ^{a}	1.78 ^{a}
Halisbey	2.57 ^{cd}	2.66 ^{bc}	2.61 ^{cd}	1.45 ^{bcd}	1.49 ^{b}	1.47 ^{b}
Wilson	2.48 ^{d}	2.54 ^{c}	2.51 ^{d}	1.41 ^{bcd}	1.43 ^{bc}	1.42 ^{b}
Com	2.67 ^{bc}	2.70 ^{bc}	2.68 ^{bc}	1.47 ^{bcd}	1.55 ^{b}	1.51 ^{b}
Sultan	2.65 ^{bc}	2.74 ^{bc}	2.69 ^{bc}	1.50 ^{bc}	1.51 ^{b}	1.51 ^{b}
Brantley	2.21 ^{e}	2.27 ^{d}	2.24 ^{e}	1.04 ^{g}	1.09 ^{d}	1.07 ^{d}
Florispan	3.11 ^{a}	3.10 ^{a}	3.11 ^{a}	1.56 ^{b}	1.44 ^{b}	1.50 ^{b}
Duzici-1	3.04 ^{a}	3.09 ^{a}	3.07 ^{a}	1.33 ^{def}	1.50 ^{b}	1.42 ^{b}
Average	2.71	2.60	2.73	1.40	1.46	1.43

$^{a-g}$Different letters shows statistical differences (P<0.05) in same column.

4. Conclusion

As a result of 2-year field experiment, the oil composition and oil content of peanut varieties were affected by the environmental conditions, genotypic differences and years. Cultivar Masal, belonging Virginia market type, had the highest unsaturated fatty acid compositions with %82.05 which consisted of 79.71% oleic acid and 2.34% linoleic acid in two-year average. Besides, the highest O/L value ratio was observed from cultivar Masal with 34.35. These results showed that cultivar Masal may be the best option because of its nutritional quality, storability, and shelf-life in second crop season in Osmaniye, Eastern Mediterranean Region of Türkiye.

Author Contributions

All task made by M.Y. (100%) data acquisition and analysis, writing up, submission and revision. The author reviewed and approved final version of the manuscript.

Conflict of Interest

The author declared that there is no conflict of interest.

Acknowledgments

I would like to thank Dr. Cenk Burak ŞAHİN who is member of Department of Field Crops, Faculty of Agriculture, Hatay Mustafa Kemal University, for analyzing data, and the directors and staff of the Oil Seeds Research Institute for contributing to the study.

References

Akcura S, Ismail TAŞ, Kökten K, Kaplan M, Bengü AŞ. 2021. Effects of irrigation intervals and irrigation levels on oil content and fatty acid composition of peanut cultivars. Notulae Botan Horti Agroboti Cluj-Napoca, 49(2): 12224-12224.

Asibuo JY, Akromah R, Adu-Dapaah HK, Kantanka OS. 2008. Evaluation of nutritional quality of groundnut (Arachis hypogaea L.) from Ghana. African J Food Agri Nutrit Devel, 8: 133-149.

Bishi SK, Lokesh K, Mahatma MK, Khatediya N, Chauhan SM, Misra JB. 2015. Quality characteristics of Indian peanut varieties and their use as nutritional and functional nutrients. Food Chem, 167: 107-114.

Candela FM, Giordano WF, Quiroga PL, Escobar FM, Mañas F, Roma DA, Sabini MC. 2020. Evaluation of cellular safety and the chemical composition of the peanut (Arachis hypogaea L.) ethanolic extracts. Heliyon, 6(10): e05119.

Cheng JH, Jin H, Liu Z. 2018. Developing a NIR multispectral imaging for prediction and visualization of peanut protein content using variable selection algorithms. Infrared Physics Technol, 88: 92-96.

Chowdhury FN, Hossain D, Hosen M, Rahman S. 2015. Comperative study on chemical composition of five varieties of groundnut (Arachis Hypogaea L.). World J Agri Sci, 11(5): 247-254.

Davis JP, Price KM, Dean LL, Sweigart DS, Cottonaro JM, Sanders TH. 2016. Peanut oil stability and physical properties across a range of industrially relevant oleic acid/linoleic acid ratios. Peanut Sci, 43(1): 1-11.

Gali S, Reddy DL, Rajesh AP, John K, Sudhakar P, Rao VS. 2021. Genetic variability studies in large seeded peanut (Arachis hypogaea L.). Pharma Innov J, 10(9): 2065-2069.

Genç S, Soysal Mİ. 2018. Parametric and nonparametric post hoc tests. BSJ Eng Sci, 1(1): 18-27.

Gölükcü M, Toker R, Tokgöz H, Kadiroğlu A. 2016. Oil content and fatty acid composition of some peanut (Arachis hypogaea) cultivars grown in Antalya conditions. Gıda, 41(1): 31-36.

Hammons RO, Herman D, Stalker HT. 2016. Origin and early history of the peanut. In Peanuts, AOCS Press, Urbana, US, pp: 1-26.

Kamdar JH, Jasani MD, Ajay BC, Rani K, Manivannan N, Vasanthi RP, Bera SK. 2021. Fatty acid desaturase-2 (ahFAD2) mutant alleles in peanut (Arachis hypogaea L.) pre-breeding lines: an insight into the source, features, discourse, and selection of novel pre-breeding lines. Genetic Ress Crop Evol, 68(2): 529-549.

Konuskan DB, Arslan M, Oksuz A. 2019. Physicochemical properties of cold pressed sunflower, peanut, rapeseed, mustard and olive oils grown in the Eastern Mediterranean region. Saudi J Biol Sci, 26(2): 340-344.

Lopez Y, Smith OD, Senseman SA, Rooney WL. 2001. Genetic factors ınfluencing high oleic acid contentin spanish market-type peanut cultivars. Crop Sci, 41: 51-56.

Matthäus B, Musazcan Özcan M. 2015. Oil content, fatty acid composition and distributions of vitamin-E-active compounds of some fruit seed oils. Antioxidants, 4(1): 124-133.

Mekdad AA, El-Enin MMA, Rady MM, Hassan FA, Ali EF, Shaaban A. 2021. Impact of level of nitrogen fertilization and critical period for weed control in peanut (Arachis hypogaea L.). Agronomy, 11(5): 909.

Salamatullah AM, Alkaltham MS, Özcan MM, Uslu N, Hayat K. 2021. Effect of maturing stages on bioactive properties, fatty acid compositions, and phenolic compounds of peanut (Arachis hypogaea L.) kernels harvested at different harvest times. J Oleo Sci, 70(4): 471-478.

Shibli S, Siddique F, Raza S, Ahsan Z, Raza I. 2019. Chemical composition and sensory analysis of peanut butter from indigenous peanut cultivars of Pakistan. Pakistan J Agri Res, 32(1): 159.

Sögüt T, Ozturk F, Kizil S. 2016. Effect of sowing time on peanut (Arachis hypogaea L.) cultivars: II. Fatty acid composition. Agri and Agricult Sci Procedia, 10: 76-82.

Stalker HT. 2017. Utilizing wild species for peanut improvement. Crop Sci, 57(3): 1102-1120.

Tang Y, Wang X, Wu Q, Fang C, Guan S, Yang W, Wang CT, Wang P. 2013. Identification of differentially expressed genes from developing seeds of a normal oil peanut cultivar and its high oil EMS mutant. Res Crop, 14: 511-516.

Wang ML, Chen CY, Tonnis B, Barkley NA, Pinnow DL, Pittman RN, Pederson GA. 2013. Oil, fatty acid, flavonoid, and resveratrol content variability and FAD2A functional SNP genotypes in the US peanut mini-core collection. J Agri Food Chem, 61(11): 2875-2882.

Xie M, Wang Z, Xu X, Zheng X, Liu H, Shi P. 2020. Quantitative estimation of the nutrient uptake requirements of peanut. Agronomy, 10(1): 119.

Yaşlı Ş, İşler N, Şahin CB. 2020. The effect of single and twin planting patterns on yield and important agricultural characteristics of main cropped peanut under Diyarbakır conditions. KSÜ Tarım ve Doğa Derg, 23(1): 91-98.

Yılmaz A, Çiftçi V. 2021. Pütresin'in tuz stresi altında yetişen yer fıstığı (Arachis hypogaea L.)'na etkisi. Avrupa Bil Teknol Derg, 1: 562-567.

Yu H, Liu H, Wang Q, Ruth S. 2020. Evaluation of portable and

benchtop NIR for classification of high oleic acid peanuts and fatty acid quantitation. LWT, 128: 109398.

Zhang J, Wang C, Tang Y, Wang X. 2009. Effects of grading on the main quality attributes of peanut kernels. Front of Agri China, 3: 291- 293.