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Certain Physical and Chemical Traits in Selected Oilseed Crops

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Abstract: Physical and chemical traits of oils from 5 soybean cultivars, three peanut cultivars, three sesame cultivars and 2 sunflower genotypes from two field experiments at the experimental station, Mansoura University, Egypt during the 2 summer seasons of 2006 and 2007 were studied. Results indicated that we can identify soybean. Giza 21 cultivar with highest values of oil percentage, saponification number, ester number and specific weight of seeds compared with other studies cultivars. Giza 35 cultivar could recognize with highest values of iodine number and Giza 22 cultivar can identify with more red and yellow color of oil compared with other studies cultivars in both seasons. Concerning peanut Giza 4 cultivar can identify by higher in moisture percentage and specific weight of seeds, more red color of oil and peroxide number compared with other studied cultivars. It possibly will be confirmed that Giza 6 cultivar could recognize with highest percentages of oil, iodine number, acid number, saponification number, ester number and more yellow color of the oil in both seasons compared with studied cultivars. Regarding sesame Taka 2 cultivar can identify by higher values of oil percentage, iodine number, saponification number, ester number, red and yellow color of oil and moisture percentage of seeds compared with studied cultivars. Giza 32 cultivar can recognize with highest values of acid number and peroxide number compared with studied cultivars in both seasons. In view of sunflower, Line 102 can identify with higher values of oil percentage, acid number peroxide number, saponification number, ester number, red color of oil and specific weight compared with Line 53 in both seasons.

Key words: Soybean, peanut, sesame and sunflower genotypes, physical and chemical traits, selected oilseed crops

INTRODUCTION

Physical and chemical identification of some oilseed crops cultivars are very important for keeping cultivars for higher production of these crops per unit area and could be used in breeding programs. From them, soybean-breeding objectives are aimed to increase content of the linoleic acid and to decrease the content of linoleic acid in order to improve of the soybean oil quality (Wolf and Cowan, 1975). Kralj (1991) reported plant seed moisture content in nine soybean cultivars. Çelik *et al.* (2001) showed that moisture content and crude oil content was varied between 7.96-9.03% and 17.25-20.71%, respectively. The refractive index, peroxide value, iodine value and saponification value of seed oil were 1.4364-1.4709, 5.91-9.41 (meq O_2 kg^{-1} fat), 118.13-132.48 and 188.38-196.23, respectively. Peske *et al.* (2004) recommended that harvesting be accomplished when the seeds are in the 15-18% MC range to minimize field deterioration. Concerning peanut genotypes differed greatly in their maturity, so many investigators studied in this respect; Çelik *et al.* (2000) found that seed moisture and crude oil ranged from 5.23 to 5.84% and 54.48 to 60.95%, respectively. The refractive index, peroxide value, iodine value and saponification value ranged from 1.4556 to 1.4652 and 1.88 to 2.75 meq O_2 kg^{-1}, 84.75 to 100.79, 187.99 to 192.77, respectively. Nemat Naguib (2000) found that the genotype Giza 5 had the highest values in crude oil compared with other studied peanut cultivars. Abd-Alla and Sorour (2004) reported that peanut genotypes varied significantly with seed traits and tests. M.32 cultivar recorded the highest values for seed oil percentage thus, they may be useful for plant breeders. Concerning sesame genotypes many investigators reported that chemical and physical characteristics can be used to identify sources of genetic materials and provide information about evolution and genetic differentiation (Nemat Naguib, 2000; Ajayi *et al.*, 2006).

Sunflower genotypes differed greatly in their maturity, so many investigators studied their differences in chemical content premeditated cultivars differences in oil yield was studied comprehensively (Sharief and Said, 1993; Bhalerao *et al.*, 1993; Araujo *et al.*, 1994; Salama, 1996; Mohamed, 1997; El-Kalla *et al.*, 1998; Esmail, 2000; Khalil *et al.*, 2000). Mandal *et al.* (2006) reported that fatty acid profile of oil was analyzed to study the range and mean values of individual fatty acids. Degree of unsaturation of the oil in terms of iodine value were

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calculated from the contents of oleic and linoleic acid and compared with literature cited values for understanding the quality of exotic sunflower oil. The objectives of this research were aimed to identify physical-chemical characteristics of some oilseed cultivars to introduce it in breeding program of new cultivars for improving oil productivity.

MATERIALS AND METHODS

Two field experiments were carried out at the Experimental Station, Faculty of Agriculture, Mansoura University, Dakhlia Governorate, Egypt during the 2 summer seasons of 2006 and 2007. The main objectives of this investigation were aimed to identify some oil chemical-physical characters of 5 soybeans (*Glycine max* L.) Merrill. cultivars i.e., Giza 21, Giza 22, Giza 35, Giza 111 and crawford; 3 peanut (*Arachis hypogaea* L.) cultivars i.e., Giza 4, Giza 5 and Giza 6; 3 sesame (*Sesamum indicum* L.) cultivars i.e., Giza 32, Shandwell 3 and Taka 2 and two sunflower (*Helianthus annuus* L.) genotypes i.e., Line 102 and Line 53 are used in this experiments. Complete block design with four replications was used. Plots were arranged in a randomized complete block design in four replications. The experimental unit area occupied an area of 10.5 m^2 consisted of 5 ridges each of 3.5 m in length and 60 cm in width. Seeds of studied soybean, peanut, sesame and sunflower cultivars were sown on 1st April and 5th June in 2006 and 2007 seasons, respectively. Plants were thinned after 21 days from sowing before the 1st irrigation to one plant per hill, 10 cm apart for soybean. Regarding to peanut genotypes, each plot occupied an area of 18.0 m^2, 5 rows each 6 m in length and 60 cm in width. Hills were spaced at 20 cm apart within the row spaced at 60 cm between rows and plants were thinned to one plant per hill before the 1st irrigation. Regarding to sesame genotypes, each genotype was grown in a plot consisted of 6 ridges, 6 m length, plot area was 18.0 m^2 and the distance between ridges was 50 and 20 cm between hill. One plant per hill was left at thinning when the plants were arrived the height 15-20 cm or when the plants are carried 4-6 leaf stage. Regarding to sunflower genotypes, the distance between hills was 20 cm and plants were thinned before the 1st watering to secure one plant per hill. Nitrogen fertilizer was added at all studied crops in the form of urea (46% N) at a rate 90 kg N ha^{-1} at two equal portions the first before the first and third irrigations. Phosphorus fertilizer at a rate 70 kg P_2O_5 ha^{-1} and potassium fertilizer at a rate 100 kg K_2O ha^{-1} were incorporated in the soil during soil preparation. Experimental soil was loamy clay in texture and available nitrogen was 24.5, 26.0 ppm and soil pH was 7.8, 8.0 and EC (dS m^{-1}) at 25 °C in both seasons, respectively. Other culture practices were followed as recommendation of ministry of agriculture and land reclamation in studied crops. Samples of 50 g of randomly dried seeds (14% moisture content) from each plot of soybean, peanut, sesame and sunflower cultivars were taken to determine the following chemical characters:

- Oil percentage was determined by Soxholet apparatus using petroleum ether as a solvent according to the method of AOAC (2000)
- Acid value was determined by taken 1 g from the oil was dissolved in 25 mL of ethanol in a dry flask. The acidity of samples was determined by titration with 0.01 N of alcoholic potassium hydroxide solution in the presence of phenolphthalein as indicator. The acid value was calculated as follows:

$$\text{Acid value} = V \times N \times 56.1 / W$$

where, V is volume in mL of KOH solution needed for neutralization. N is normality of KOH. W is weight of sample in gram (AOAC, 2000)

- Iodine number was determined according to the AOAC (2000) methods using Hans's method according to the following formula:

$$\text{Iodine No.} = (a - b) \times N \times 126.9 \times 100 / W \times 100$$

where, a is titration volume of sodium thiosulphate solution in mL required for blank, b is titration volume of sodium thiosulphate solution in mL required for sample, N is normality of sodium thiosulphate solution and W is weight of oil sample in gram

- Peroxide value was determined by the iodometric method described by AOAC (2000) according to the following formula:

$$\text{Peroxide value} = V \times N \times 1000 / W$$

where, V is volume in mL of sodium thiosulphate needed for titration, N is normality of sodiumthiosulphate solution and W is weight of oil sample in gram

- Saponification value was determined by the iodometric method described by AOAC (2000) according to the formula for calculating saponification number (mg KOH required to saponify 1g fat) = 28.05 (B - S) g oil, where, B is mL

0.5 M HCl required by blank. S is mL 0.5 N HCl required for sample

- Ester number was calculated from the saponification value by the following equation (AOAC) 2000:

$$\text{Ester No.} = S.V / A.V$$

- Regarding physical characters determination of refraction index, color of oil, specific weight of seed and moisture percentage of seed were preformed according to methods described by AOAC (2000)

All data were statistically analyzed according to the technique of Analysis of Variance (ANOVA) for the randomized complete block design. While, in case of no Significant Differences (NS) there is no LSD as published by Gomez and Gomez (1984). All statistical analysis were carried out using analysis of variance technique (ANOVA) with MSTAT–C statistical software program (Freed *et al*., 1989). For mean grouping, Least Significant Differences (LSD) analyzing method was used to test the differences between treatment means at 5% (in case of significant differences (*) and 1% in case of highly significant differences (**) level of probability.

RESULTS AND DISCUSSION

Soybean physical-chemical characters: Results in Table 1 and 2 noticeably indicate that studied cultivars soybean cultivars significantly differed in both 2006 and 2007 seasons except refractive index of oil in both seasons insignificantly affected of all studied soybean cultivars. We can identify Giza 21 cultivar by highest values of oil percentage, saponification number and ester number of the oil in both seasons compared with studied cultivars. It may possibly be notice that we can identify Giza 35 cultivar with highest iodine number in both seasons compared with studied cultivars. Giza 22 cultivar can recognize with more red and yellow color of oil in both seasons compared with studied cultivars.

Crawford cultivar could recognize with highest increase in acid number of oil compared with studied cultivars and highest values of peroxide number without significant differences with Giza 35 cultivar compare with other studied cultivars in both seasons. Concerning, Giza 21 and Giza 111 cultivars could recognize with highest values in specific weight of seeds in both seasons compared with studied cultivars. In addition, Giza 111 cultivar can recognize with the lowest values of iodine, peroxide, saponification and ester, No. color of oil in both seasons compared with studied cultivars. The difference between soybean cultivars in all accessible results might be reflecting to the genetically factors and soybean maturity group. The differences among the studied cultivars supplies useful information for genotypes identification and classification of soybean. Peske *et al.* (2004) suggested that harvesting be accomplished when the seeds are in 15-18% MC range

Table 1: Mean values of oil, iodine, acid, peroxide, saponification and ester No. as affected by soybean oil cultivars in 2006 and 2007 seasons

	Oil (%)		Iodine No.		Acid No.		Peroxide No.		Saponification No.		Ester No.	
Cultivars	2006	2007	2006	2007	2006	2007	2006	2007	2006	2007	2006	2007
Giza 21	22.6	22.9	124.5	123.6	0.107	0.113	3.76	3.88	163.7	163.7	163.5	163.5
Giza 22	20.9	21.3	137.2	138.1	0.168	0.168	3.31	3.36	153.1	158.4	157.8	157.9
Giza 35	22.0	22.1	139.1	140.1	0.210	0.211	5.05	4.93	160.1	160.3	159.8	162.0
Giza 111	21.0	21.7	120.1	120.7	0.223	0.220	1.60	1.56	153.1	153.3	152.9	153.1
Crawford	22.6	22.9	127.0	127.5	0.374	0.375	5.00	5.06	160.9	161.1	160.6	160.6
F-test	**	**	**	**	**	**	**	**	**	**	**	**
LSD 5%	0.4	0.2	1.9	0.8	0.007	0.004	0.18	0.15	0.9	0.7	0.8	1.5
LSD 1%	0.5	0.3	2.6	1.1	0.009	0.006	0.25	0.21	1.2	1.1	1.1	2.1

**Significant difference at 1% level of probability

Table 2: Mean values of color of oil, refractive index of oil, specific weight of seeds (mL) and moisture (%) of seeds for soybean cultivars in 2006 and 2007 seasons

	Color of oil									
	Red		Yellow		Refractive index of oil		Specific weight of seeds (mL)		Moisture of seeds (%)	
Cultivars	2006	2007	2006	2007	2006	2007	2006	2007	2006	2007
Giza 21	3.5	3.6	3.5	3.5	1.46	1.46	2.1	2.1	9.1	9.5
Giza 22	6.0	6.4	6.0	6.2	1.46	1.46	1.3	1.4	9.7	9.6
Giza 35	4.2	4.5	4.2	4.3	1.46	1.46	0.8	0.9	10.7	10.8
Giza 111	3.2	3.2	3.2	3.3	1.46	1.46	2.0	2.3	10.3	10.4
Crawford	3.0	3.1	3.0	3.1	1.46	1.46	1.3	2.1	10.6	10.7
F. test	**	**	**	**	NS	NS	**	**	**	**
LSD 5%	0.5	0.5	0.5	0.3	----	----	0.3	0.3	0.2	0.1
LSD 1%	0.7	0.7	0.7	1.4	----	----	0.4	0.5	0.3	0.2

NS: Not significant, **Significant difference at 1% level of probability

to minimize field deterioration. Similar results were reported by Kralj (1991) and Celik *et al.* (2001).

Peanut physical-chemical characters: Results in Table 3 and 4 evidently show that studied peanut cultivars significantly differ in both 2006 and 2007 seasons except refractive index insignificantly affected by studied cultivars in both seasons. It possibly will be confirmed that Giza 6 cultivars can identify with highest percentages of oil, iodine, acid, saponification and ester No. and more yellow color of the oil in both seasons compared with studied cultivars. Giza 4 cultivar could identify by highest values of peroxide number, heaviest red color of oil, specific weight of seeds and moisture percentage of seeds compare with studied cultivars in both seasons. However Giza 5 cultivar can recognize with the lowest values of oil percentage, acid and peroxide No. yellow, color of oil and specific weight of seed in both seasons compared with studied cultivars.

Regarding the seed moisture percentage, Giza 6 can identify with the lowest percentages in this trait in both seasons. In both seasons, refractive index insignificantly affected oil of studied peanut cultivars seed. The difference among peanut cultivars in studied traits might be reflect to the genetically factors among the three genotypes which differ in moisture percentage of seeds and chemical oil characteristics among the cultivars supplies useful information for genotypes classification. The differences in their genetically constitution for these traits may be due to the interaction between the genetically structure for these traits and interaction between the genetically make-up and the current environmental conditions during the experimentation period. Many investigators came to the same results such as Abd-Alla and Sorour (2004) reported that peanut cultivars varied significantly with seed traits and tests. M.32 cultivar recorded the highest values for seed oil percentage and thus, they may be beneficial for plant breeders. Similar results were reported by Çelik *et al.* (2000), Nemat Naguib (2000) and Ajayi *et al.* (2006).

Sesame physical-chemical characters: Results in Table 5 and 6 obviously indicate that studied sesame cultivars significantly differed in both 2006 and 2007 seasons except refractive index of oil in both season and specific weight of seeds in the first season only. It possibly will be notice that Taka 2 cultivar can identify by more percentage of oil and highest values of iodine, saponification and ester No. more red and yellow color of oil, moisture percentage of seeds in both seasons as well as specific weight of seed in the second season compare with other studied cultivars. Giza 32 cultivar can recognize with highest values of acid and peroxide No. compared with other studied cultivars in both seasons. However, Shandwell 3 cultivar could identify with the lowest values of oil percentage, iodine, acid, saponification and ester No. seed moisture percentage in both seasons compare with studied cultivars. The difference among the studied traits of the three sesame cultivars may be attributed to the differences in their genetically constitution for these traits and interaction between the genetically structure for these traits and interaction between the genetically make-up and the environmental conditions current during the experimentation period.

Table 3: Mean values of oil, iodine, acid, peroxide, saponification and ester No. of oil peanut cultivars in 2006 and 2007 seasons

	Oil (%)		Iodine No.		Acid No.		Peroxide No.		Saponification No.		Ester No.	
Cultivars	2006	2007	2006	2007	2006	2007	2006	2007	2006	2007	2006	2007
Giza 4	46.4	46.1	136.8	136.7	0.038	0.031	3.80	3.83	125.5	124.8	125.4	124.4
Giza 5	48.7	47.7	139.0	138.9	0.028	0.026	2.73	2.80	143.4	143.9	143.3	143.4
Giza 6	51.7	51.9	140.9	140.7	0.036	0.036	3.45	3.60	150.0	150.0	149.9	150.0
F-test	**	**	**	**	**	**	**	**	**	**	**	**
LSD 5%	0.6	0.2	0.3	0.4	0.001	0.001	0.11	0.14	0.5	0.3	0.4	0.4
LSD 1%	0.8	0.3	0.4	0.6	0.002	0.009	0.16	0.20	0.7	0.4	0.6	0.6

**Significant difference at 1% level of probability

Table 4: Mean values of color of oil (red and yellow color), refractive index of oil, specific weight of seeds (mL) and moisture (%) for peanut oil cultivars in 2006 and 2007 seasons

	Color of oil									
	Red		Yellow		Refractive index of oil		Specific weight of seeds (mL)		Moisture of seeds (%)	
Cultivars	2006	2007	2006	2007	2006	2007	2006	2007	2006	2007
Giza 4	1.1	1.3	3.0	2.9	1.461	1.461	2.95	2.90	7.50	7.8
Giza 5	0.7	0.8	2.0	2.2	1.462	1.461	1.83	1.81	6.40	7.7
Giza 6	0.6	0.7	5.0	5.2	1.462	1.462	1.86	1.95	6.30	6.5
F-test	*	*	**	**	NS	NS	**	**	**	**
LSD 5%	0.2	0.3	0.4	0.3	-----	-----	0.28	0.22	0.40	0.3
LSD 1%	----	----	0.6	0.5	-----	-----	0.39	0.31	0.06	0.4

NS: Not significant; *, **Significant difference at 5 and 1% level of probability, respectively

Table 5: Mean values of oil percentage, iodine, acid, peroxide, saponification and ester No. of oil sesame cultivars in 2006 and 2007 seasons

	Oil (%)		Iodine No.		Acid No.		Peroxide No.		Saponification No.		Ester No.	
Cultivars	2006	2007	2006	2007	2006	2007	2006	2007	2006	2007	2006	2007
Giza 32	54.1	54.7	155.0	155.4	0.055	0.056	7.40	7.61	164.3	163.9	164.3	163.7
Shandwe ll3	49.8	49.8	154.2	154.3	0.017	0.017	6.25	6.45	162.1	161.4	162.1	161.4
Taka 2	55.6	55.8	190.1	189.9	0.019	0.195	2.48	2.51	171.7	171.3	171.2	171.3
F-test	**	**	**	**	**	**	**	**	**	**	**	**
LSD 5%	0.5	0.6	0.6	0.5	0.003	0.001	0.13	0.15	0.4	0.3	0.5	0.2
LSD 1%	0.8	0.8	0.9	0.7	0.004	0.002	0.19	0.22	0.6	0.4	0.7	0.4

**Significant difference at 1% level of probability

Table 6: Mean values of color of oil (red color and yellow color) and refractive index of oil for seed oil specific weight of seeds and moisture percentage of oil sesame cultivars in both seasons

	Color of oil									
	Red		Yellow		Refractive index of oil		Specific weight of seeds (mL)		Moisture of seeds (%)	
Cultivars	2006	2007	2006	2007	2006	2007	2006	2007	2006	2007
Giza 32	1.6	1.7	6.0	5.8	1.46	1.46	1.63	1.7	5.9	9.1
Shandwe ll3	2.5	2.5	6.0	5.6	1.48	1.48	2.00	2.2	5.5	6.2
Taka 2	4.0	4.0	30	30.3	1.44	1.47	1.66	2.3	8.1	8.8
F-test	**	**	**	**	NS	NS	NS	**	**	**
LSD 5%	0.3	0.3	0.6	0.6	----	----	----	0.2	0.5	0.3
LSD 1%	0.4	0.5	0.9	0.8	----	----	----	0.3	0.7	0.5

NS: Not significant, **Significant difference at 1% level of probability

Table 7: Mean values of oil percentage, iodine, acid, peroxide, saponification and ester No. of oil for sunflower cultivars in 2006 and 2007

	Oil (%)		Iodine No.		Acid No.		Peroxide No.		Saponification No.		Ester No.	
Genotypes	2006	2007	2006	2007	2006	2007	2006	2007	2006	2007	2006	2007
Line 102	33.3	33.6	167.6	168.0	0.26	0.26	18.08	18.05	182.9	183.9	182.7	182.6
Line 53	35.8	36.5	168.4	167.2	0.19	0.20	12.95	13.05	131.4	131.3	131.2	131.0
F-test	*	**	NS	NS	**	**	**	**	**	**	**	**

NS: Not significant, *, **Significant difference at 5 and 1% level of probability, respectively

Table 8: Mean values of color of oil (red and yellow color) and refractive index of oil for seed oil specific weight of seeds and moisture percentage for sunflower cultivars in 2006 and 2007

	Color of oil									
	Red		Yellow		Refractive index of oil		Specific weight of seeds (mL)		Moisture of seeds (%)	
Genotypes	2006	2007	2006	2007	2006	2007	2006	2007	2006	2007
Line 102	1.81	1.81	10.33	10.33	1.467	1.467	2.3	2.4	7.9	9.0
Line 53	1.81	1.65	20.33	20.50	1.465	1.465	1.9	2.1	9.1	9.8
F .test	NS	**	**	**	NS	NS	**	**	**	**

NS: Not significant, **Significant difference at 1% level of probability

Similar results were reported by Nemat Naguib (2000) pointed out that Giza 32 cultivar surpass new arrival 256, SS hybrid and hybrid 102 other three genotypes for crude protein. Similar conclusions were reported by Ajayi *et al.* (2006).

Sunflower physical-chemical characters: Results in Table 7 and 8 evidently show that intentional sunflower cultivars significantly differed in both 2006 and 2007 seasons except refractive index and iodine number of oil in both seasons and red color of oil in the first season which did not reach the level of significant of studied sunflower genotypes. It may possibly be stated that Line 102 can identify with highest values of acid, peroxide, saponification and ester No. and specific weight of seed compared with Line 53 in both seasons. Line 53 can recognize with highest percentages of oil, more yellow color of the oil and highest percentages of moisture in seed compare Line 102 in both seasons. Regarding refractive index and iodine number of oil in both seasons and red color of oil in the first season were did not reach the level of significant of studied sunflower genotypes. The difference connecting sunflower genotypes in the studied traits may be due to the genetically factors and inherited variation among the two genotypes which supplies useful information for genotypes identification. Many investigators came to the similar results such as Araujo *et al.* (1994) studied physico-chemical

characterization and their oil percentage was determined. Oil content ranged from 35.7% in DK 180 cultivar to 44.3% in control cultivar. The values found for the refraction, iodine and saponification indices were in agreement with the ranges found by other researchers. Khalil *et al.* (2000) reported that seed oil content ranged from 33.73 to 43.53% and the highest yielding Hysun-33 and Peshawar-93 hybrids also contained the highest amount of oil. Similar results were reported by El-Kalla *et al.* (1998), Esmail (2000) and Mandal *et al.* (2006).

CONCLUSION

It possibly will be summarize that we can use physical and chemical traits' identification of soybean, peanut, sesame and sunflower cultivars which supplies useful information in breeding program of new cultivars to keep and preservation higher assembly for these oilseed productivity.

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