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Grain Qualities, Oil Yields and Fatty Acid Composition of Some Hybrid Dent Corn Varieties

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In this study, the crude oil, protein, ash, potassium, sodium, ferrous content in corn grain and the characteristics of corn oil such as fatty acid composition, iodine value and specific gravity were determined of 35 hybrid dent corn varieties grown in Tekirdag ecological condition. The average grain yield was found betwwen 1099.32-796.32 kg/da in the corn varieties. The crude protein content in the analyzed varieties was ranged between 5.3 and 9.9 %. Among analyzed samples the oil content of corn varieties changed from 2.40 to 5.20 %. Variety G-626 had the higher saturated fatty acid (SFA), palmitic acid and oleic acid (MUFA) content from than the other varieties.

Key Words: Dent corn, Protein, Mineral, Crude oil, Fatty acids.

INTRODUCTION

Maize (*Zea mays* L.) or corn, is the most important cereal crop in the world with rice and wheat, providing nutrients for humans and animals and serving as a basic raw material for the production of starch, oil and protein, alcoholic beverages, food sweeteners and more recently, fuel[1-3]. Every part of the maize plant has economic value since the grain, leaves, stalk, tassel and cob can all be used to produce a large variety of food and non-food products. In industrialized countries maize is largely used as livestock feed and as a raw material for industrial products, while in less developed countries it is mainly used for human consumption[4].

It's known that the maize production in the world is used as 27 % for human nutrition and 73 % for animal feed. Also, the ratios of these values in developed countries are 45.9 % for animal feed and 54.1 % for human nutrition and industrial material[2]. The information on total protein, oil and nutritional content of grain is important for nutritionist, users, industry and they are interested in more specific details on the quality of the proteins and fats in grain. There were different researches on the chemical and nutritional composition of corn grain in recent years. Kent[5]

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reported the protein, crude oil and ash content of corn as 10, 4.3 and 1.5 %, respectively. The protein content of different corn varieties varied from 6 to 12 % on a dry matter basis and about 75 % of the protein is contained in the endosperm tissue[6].

Corn oil is non-hydrogenated oil and high in polyunsaturated. It is used for frying, as a shortening in baking, salad dressings and margarine[3]. The corn oil including high unsaturated fatty acid composition is ideal vegetable oil for grow up, kidney, skin and pregnancy period[2]. In addition, linoleic acid increases to lay eggs, egg quality and resistance to diseases of chicken[7]. Corn oil is highly effective food oil for lowering serum cholesterol. Because of its low content of saturated fatty acids (SFAs) which raises cholesterol and its high content of polyunsaturated fatty acid (PUFAs) which lowers cholesterol. Consumption of corn oil can replace SFAs with PUFAs and the combination is more effective in lowering cholesterol than simple reduction of SFAs[8]. Schurgers and Vermeer[9] determined that corn oil significantly decreased the thrombosis risk. The relative concentration of essential monounsaturated fatty acids (such as oleic acid) and polyunsaturated fatty acids (such as linolenic acid) may affect end uses of specialty of grains. In the future, corn oil high in palmitic acid may be in demand for margarine production, requiring less chemical processing whereas cooking oils derived from corn high in oleic acid would be beneficial to consumers' health[10].

In this study we aimed to determine the crude oil, protein, ash, potassium, sodium, ferrous content in corn grain and the characteristics of corn oil such as fatty acid composition, iodine value and specific gravity. The obtained results were evaluated in relation to nutrition and industrial uses. In addition, the some important characteristics in corn varieties were compared to determine the best genotypes.

EXPERIMENTAL

35 Hybrid dent corn varieties were used as material in this experiment which was carried out in Tekirdag ecological condition. This research was conducted according to randomized block design with three replications. Sowing was made by hand in 4-rowed plots having 2.8 m width and 5 m length. In each plot 0.7 m space between rows and 5 m row length were given. Two times fertilization was applied as on the base of 20 kg pure nitrogen and 8 kg pure phosphorous in sowing and following second hoeing. The control of weeds plants were worked out by hand hoe. Three times furrow irrigation were applied. Ears of plants were harvested in the time of maturation by hand and then, separated from cobs and grains were dried to 14 % moisture content. The grains were threshed by hand band, the grains weighted and obtained yield values were calculated for decare grain yield.

Chemical analysis: The grains of corn were grinded by using a mill (FT2 Laboratory Hammer Mill Armfield) for analysis. Ash, oil, Na, K and Fe concentrations were determined by AOAC[11]. Sodium and potassium determinations were carried out by using a flame photometer (PFP 7, Jenway). Iron determination was made by

using atomic absorption spectrophotometer. Protein contents of corn samples were obtained thorough Perten inframatic 8600. Fatty acid compositions and characteristic of oils were determined by using IUPAC model Gas-Liquid Chromatography.

Statistical analysis: Statistical analysis was carried out to method given by Steeel and Turnie[12] using MSTAT packaged program.

RESULTS AND DISCUSSION

Mean values and their significant levels for contents of crude oil, protein, ash, sodium, potassium and ferrous in grain and oil characteristics such as fatty acid composition, iodine value, specific gravity are given in Tables 1-3. Protein quality is one of major component of quality in maize. The crude protein content ranged from 5.3 % (variety P 3167) to 9.9 % (variety Ag 9241). Ada 523, Pegaso and C 955 were found lower protein content from P 3167.

Ash, sodium, potassium and ferrous contents of corn varieties were changed between as 0.765-1.250 %, 0.135-2.15 %, 0.154-0.375 % and 3.27-77.09 mg/kg, respectively (Table-1). Considerable variations were found significant for those characteristics. The lowest ash and ferrous content were obtained in variety Ada 523. Varieties AG 9242 and Gözdem had the lowest content of potassium and sodium. The highest ash and sodium content were found in varieties AG 9242 and Mocejan. As for potassium and ferrous content, highest values were determined from varieties Trakya 613 and Karaçay.

Among analyzed samples the crude oil content of corn varied from 2.40 % (variety 31K61) to 5.20 % (variety H-2581) (Table-1). Varieties "H-2581 and 359P12" had the highest oil content and varieties Gözdem, G-126 and Doge followed them while varieties AG 9242 and TTM 815 showed the lower oil contents among the varieties. The average value for crude oil overall experimental material in this study was found 3.70 % and our results were found lower than findings of Belyea *et al.*[13], (4.25 %) and Kirtok[2] (5 %).

The lowest and highest unsaturated fatty acid contents were obtained in varieties G-126 (78.92 %) and Trakya 613 (86.48 %), respectively. The varieties Brasko, Tector and 359P12 were found the higher unsaturated fatty acid content than other varieties. The saturated fatty acid content varied from 13.52 % (variety Trakya 613) to 21.08 % (variety G-126). The iodine value of corn oils changed between 95.89-125.26 % (Table-3). It's shown that, the variety G-126 which was the highest saturated fatty acid content had the lowest iodine value. It's known that the oils which are the higher iodine value have rich unsaturated fatty acid content.

Specific gravity (nD40 ºC) of crude oils changed between 1.4637 and 1.4721. The highest specific gravity value was obtained from variety H-2547 in spite of the lowest value was determined from variety Trakya 613 (Table-3). Present results were found different and higher from results of refine oil[3]. Differences between results may explain cause of present results which were obtained from crude oil.

TABLE-1
SOME IMPORTANT NUTRITIONAL COMPONENTS OF CORN VARIETIES

Corn varieties	Crude oil (g/100 g)	Protein (g/100 g)	Ash (g/100 g)	Na (g/100 g)	K (g/100 g)	Fe (mg/kg)	Tane verimi (kg(da)
G-626	4.41^{cd}	6.5^{e-j}	1.044^{ghi}	0.186^{c-f}	0.305^{e-h}	24.15^{mn}	879.63 $^{f-m}$
Pegaso	3.94^{f-i}	5.9^{jkl}	1.011^{jkl}	0.183^{efg}	0.277^{ijk}	25.69^{klm}	862.92 $^{i-m}$
VHD	3.31^{nop}	6.4^{f-j}	1.036^{hij}	0.199^{b}	0.275^{ijk}	31.75^{g-j}	850.87 ^{klm}
H-2581	**5.20^{a}**	6.6^{e-j}	1.117^{e}	0.171^{jkl}	0.257^{kl}	71.42^{ab}	990.94 $^{b-e}$
H-2547	3.26^{op}	7.2^{c-f}	1.197^{b}	0.163^{lmn}	0.291^{f-j}	49.40^{d}	865.12 $^{h-m}$
Trebia	3.58 $^{j-o}$	6.4^{f-j}	1.080^{f}	0.149^{prs}	0.305^{e-h}	19.67^{no}	902.05 $^{e-l}$
Tector	3.19^{pr}	7.9^{bc}	1.072^{fg}	0.215^{a}	0.289^{f-j}	36.21^{efg}	888.32 $^{f-m}$
P-3394	**4.63^{bc}**	6.3^{g-k}	1.002^{kl}	0.166^{klm}	0.165^{m}	28.64^{h-m}	961.27 $^{c-i}$
AG 92140	3.26^{op}	6.4^{f-j}	1.005^{ijk}	0.157^{nop}	0.275^{ijk}	34.31^{e-h}	937.52 $^{c-k}$
Ag 9241	4.30^{e-f}	9.9^{a}	1.178^{bc}	0.185^{def}	0.305^{e-h}	26.31^{j-m}	886.77 $^{f-m}$
Trakya 613	3.56^{k-o}	6.8^{e-i}	1.066^{fgh}	0.193^{bcd}	0.375 ^{a}	32.27^{f-i}	970.40 $^{b-g}$
OSSK 644	3.35^{nop}	6.8^{e-i}	0.901^{n}	0.173^{h-k}	0.232^{l}	30.06^{h-l}	835.97 ^{lm}
DK-647	3.74^{i-m}	6.1^{h-l}	0.902^{n}	0.162^{mno}	0.270^{ijk}	38.32^{e}	**1099.32 ^{a}**
Dracma	3.26^{o-p}	6.5^{e-j}	1.139^{de}	0.189^{cde}	0.286^{hi}	25.12^{klm}	**1070.63 ^{ab}**
Brasko	4.37^{cde}	6.0^{i-l}	0.892^{no}	0.144st	0.272^{jk}	70.37^{b}	983.32 $^{b-f}$
359P12	**4.94^{ab}**	8.2^{b}	1.193^{b}	0.198^{b}	0.305^{e-h}	58.25^{c}	960.75 $^{c-i}$
Gözdem	3.79^{g-l}	7.0^{d-g}	0.850^{p}	0.135^{u}	0.288^{g-j}	58.08^{c}	859.67 ^{klm}
Karaçay	4.00^{f-j}	6.9^{e-h}	0.771^{r}	0.164^{lmn}	0.296^{e-j}	77.09^{a}	911.39 $^{d-l}$
TTM 81-19	3.42^{m-p}	6.7^{e-j}	0.946^{m}	0.159^{mno}	0.301^{e-i}	63.07^{hl}	883.48 $^{f-m}$
AG 9229	3.32^{nop}	6.7^{e-j}	1.208^{b}	0.194^{bc}	0.231^{l}	46.38^{d}	1012.19 $^{a-d}$
AG 9242	2.89^{r}	7.3^{cde}	1.250^{a}	0.173^{h-k}	0.154^{m}	36.06^{efg}	976.66 $^{b-g}$
Mocejan	3.58^{i-o}	6.8^{e-i}	1.126^{de}	0.209^{a}	0.291^{f-j}	31.10^{g-k}	834.84 ^{lm}
TTM 815	3.19^{pr}	6.5^{e-j}	0.943^{m}	0.171^{jkl}	0.302^{e-i}	38.17^{ef}	965.21 $^{c-h}$
Balkan	3.49^{l-p}	6.7^{e-j}	0.677^{s}	0.148^{rs}	0.311^{c-h}	44.12^{d}	939.39 $^{c-k}$
C 955	3.97^{e-h}	5.9^{jkl}	1.182^{b}	0.138^{tu}	0.270^{ijk}	12.45^{prs}	900.58 $^{e-l}$
RX 9292	3.33^{nop}	7.8^{bcd}	1.055^{fi}	0.181^{e-h}	0.308^{d-h}	15.25^{op}	823.60 ^{lm}
31G98	3.60^{j-o}	6.6^{e-j}	1.046^{ghi}	0.184^{def}	0.340^{b}	24.29^{lmn}	876.08 $^{g-m}$
P 3167	3.90^{f-k}	5.3^{l}	0.934^{m}	0.162^{mno}	0.287^{hi}	28.11^{i-m}	909.40 $^{e-l}$
31K61	2.40^{s}	7.3^{cde}	0.864^{op}	0.174^{h-k}	0.255^{kl}	12.85^{pr}	939.98 $^{c-k}$
Vero	3.28^{nop}	6.3^{g-k}	1.055^{f-i}	0.154^{opr}	0.306^{d-h}	12.06^{prs}	857.01 ^{klm}
Doge	4.25^{d-g}	6.7^{e-j}	0.993^{l}	0.180^{f-i}	0.333^{bcd}	6.95st	911.88 $^{d-l}$
Ada 523	3.37^{nop}	5.5^{kl}	0.765^{r}	0.161^{mno}	0.321^{bcd}	3.27^{t}	972.44 $^{b-g}$
Arifiye	4.04^{e-h}	9.5^{a}	1.150^{cd}	0.180^{i}	0.316^{b-f}	7.59^{rst}	796.32 ^{m}
Ada 9510	3.92^{f-j}	7.2^{c-f}	1.039^{hij}	0.175^{g-j}	0.315^{b-g}	11.46^{prs}	864.90 $^{h-m}$
Ada 9516	3.63^{h-m}	6.2^{g-k}	1.181^{de}	0.186^{c-f}	0.338^{bc}	66.17^{bc}	**1020.87 ^{abc}**
Mean	3.70	6.8	1.024	0.174	0.286	34.19	919.08
LSD% 5	0.356	0.835	0.306	0.086	0.279	5.847	101.25

Corn oil has rich linoleic acid content and this fatty acid cannot be synthesized by human enzymes endogenously so it is essential fatty acid (EFA) in human nutrition. In this study average major fatty acids contents was obtained as 12.41 % palmitic acid (C 16:0), 2.66 % stearic acid (C18:0), 32.14 % oleic acid (C18:1), 48.70 % linoleic acid (C18:2) and 1.17 % linolenic acid (C18:3). Linoleic acid content of oils varied from 36.02 to 56.83 % (Table-2). As seen in Table-3, linoleic acid contents

TABLE-2
FATTY ACID COMPOSITIONS (%) OF CRUDE OILS OBTAINED FROM DENT CORN VARIETIES

Varieties	C6:0	C8:0	C10:0	C12:0	C14:0	C16:0	C16:1	C17:0	C17:1	C18:0	C18:1	C18:2	C18:3	C20:0	C20:1	C22:0	C22:1	C22:2	C24:0	C24:1
G-626	0.04^{g}	0.05^{c}	0.24^{cd}	0.08^{b}	0.02^{bc}	16.78^{a}	0.48^{a}	0.11^{b}	0.04^{d}	3.24^{bc}	39.24^{a}	36.02^{p}	0.69^{G}	0.65^{bc}	0.22^{n}	0.18^{e-h}	0.87^{a}	0.73^{c}	0.23^{k}	0.09
Pegaso	0.42^{b}	0.02^{de}	0.08^{ghi}	0.06^{cd}	0.03^{ab}	13.84^{ab}	0.45^{b}	0.09^{e}	0.04^{d}	2.45^{k-s}	31.10^{h-m}	48.06^{h-l}	1.33^{i}	0.53^{g-i}	0.29^{j}	0.19^{d-g}	0.20^{g}	0.29^{e}	0.29^{e}	-
VHD	0.96^{a}	0.29^{a}	nd	0.05^{de}	0.03^{ab}	12.39^{bc}	0.29^{k}	0.09^{e}	0.05^{c}	2.61^{e-m}	29.45^{j-o}	52.23^{cde}	0.06^{i}	0.56^{f-i}	0.30^{i}	0.24^{c}	0.06^{ij}	0.08^{r}	0.26^{g}	-
H-2581	nd	nd	0.03^{hi}	0.06^{cd}	0.02^{bc}	11.44^{bc}	0.33^{g}	0.08^{f}	0.03^{e}	2.82^{d-g}	30.29^{i-m}	52.02^{cde}	1.19^{s}	0.47^{l}	0.27^{l}	0.32^{b}	0.23^{f}	0.08^{r}	0.22^{l}	0.05
H-2547	0.03^{gh}	0.05^{c}	0.27^{bc}	0.06^{cd}	nd	14.13^{ab}	0.30^{i}	0.10^{c}	0.04^{d}	3.68^{a}	31.60^{gl}	46.10^{j-m}	0.55^{h}	0.71^{a}	0.31^{h}	0.23^{cd}	0.59^{b}	0.75^{b}	0.41^{a}	0.09
Trebia	nd	nd	nd	0.04^{ef}	nd	12.59^{bc}	0.26^{m}	0.08^{f}	0.03^{e}	2.42^{k-s}	26.04^{p}	55.96^{ab}	1.33^{i}	0.53^{g-i}	0.20^{p}	0.16^{gh}	0.06^{m}	0.07^{s}	0.23^{k}	-
Tector	nd	nd	0.02^{i}	0.05^{de}	nd	11.07^{bc}	0.31^{h}	0.08^{f}	0.03^{e}	2.26^{rst}	26.49^{op}	56.83^{a}	1.61^{b}	0.50^{i-e}	0.31^{h}	0.17^{fgh}	0.03^{o}	0.05^{v}	0.19^{o}	-
P-3394	nd	nd	0.03^{i}	0.06^{cd}	nd	13.29^{ab}	0.39^{c}	0.09^{e}	0.06^{b}	2.14^{t}	29.14^{j-p}	51.84^{c-f}	1.73^{a}	0.48^{h-k}	0.21^{o}	0.15^{gh}	0.07^{lm}	0.26^{g}	0.25^{h}	-
AG 92140	nd	0.01^{ef}	0.15^{e-h}	0.05^{de}	nd	13.62^{ab}	0.33^{g}	0.10^{c}	0.05^{c}	2.80^{d-g}	30.62^{h-n}	49.47^{f-j}	1.25^{n}	0.58^{d-g}	0.29^{j}	0.18^{e-h}	0.14^{k}	0.09^{p}	0.27^{f}	-
Ag 9241	nd	nd	0.01^{i}	0.04^{ef}	nd	11.82^{bc}	0.28^{l}	0.01^{h}	0.05^{c}	2.67^{e-k}	34.53^{b-y}	47.51^{j-m}	0.97^{A}	0.52^{h-k}	0.24^{m}	0.15^{gh}	0.08^{h}	0.95^{a}	0.17^{p}	-
Trakya 613	0.04^{g}	0.014^{b}	0.02^{i}	0.04^{ef}	nd	10.55^{bcd}	0.24^{o}	0.07^{g}	0.02^{f}	2.53^{i-p}	29.05^{j-p}	55.07^{ab}	1.18^{t}	0.49^{j-k}	0.31^{h}	0.14^{h}	0.04^{e}	0.24^{h}	0.14^{t}	-
OSSK 644	nd	nd	0.08^{ghi}	0.05^{de}	nd	12.80^{b}	0.28^{l}	0.10^{c}	0.04^{d}	2.83^{def}	34.61^{b-g}	46.58^{km}	1.17^{u}	0.61^{cde}	0.29^{j}	0.14^{h}	0.04^{e}	0.24^{h}	0.14^{t}	-
DK-647	0.11^{e}	0.03^{cd}	nd	0.05^{de}	0.04^{a}	11.99^{bc}	0.31^{h}	0.11^{b}	0.04^{d}	2.65^{f-l}	27.91^{m-p}	53.97^{bcd}	1.33^{i}	0.57^{e-h}	0.20^{p}	0.31^{b}	0.04^{e}	0.09^{p}	0.29^{e}	-
Dracma	nd	0.05^{c}	0.19^{cde}	0.07^{bc}	0.04^{a}	12.41^{bc}	0.28^{l}	0.09^{e}	0.06^{b}	3.43^{b}	31.99^{f-k}	48.25^{g-k}	0.95^{C}	0.59^{def}	0.21^{o}	0.48^{a}	0.39^{d}	0.19^{l}	0.33^{c}	-
Brasko	nd	nd	nd	0.04^{ef}	nd	10.62^{bcd}	0.31^{h}	0.13^{a}	0.06^{b}	2.52^{k-r}	27.48^{n-p}	55.95^{ab}	1.57^{c}	0.48^{kl}	0.28^{k}	0.18^{e-h}	0.06^{m}	0.09^{p}	0.23^{k}	-
359P12	nd	nd	nd	0.05^{de}	nd	11.12^{bc}	0.29^{k}	0.08^{f}	0.03^{e}	2.31^{n-t}	35.15^{b-p}	48.14^{h-l}	1.23^{o}	0.59^{def}	0.36^{d}	0.21^{c-f}	0.14^{k}	0.14^{m}	0.16^{r}	-
Gözdem	0.14^{d}	nd	nd	0.35^{a}	0.01^{cd}	10.89^{bc}	0.28^{l}	0.08^{f}	0.05^{c}	2.34^{m-t}	36.57^{a-d}	46.31^{j-m}	0.90^{E}	0.54^{g-j}	0.30^{i}	0.15^{gh}	0.18^{h}	0.20^{k}	0.15^{s}	-
Karaçay	0.21^{c}	nd	0.06^{hi}	0.04^{ef}	nd	13.05^{b}	0.19^{s}	0.09^{e}	0.05^{c}	2.58^{g-n}	36.90^{abc}	43.97^{mn}	0.96^{B}	0.66^{b}	0.28^{k}	0.19^{d-g}	0.26^{e}	0.27^{f}	0.24^{i}	-
TTM 81-19	nd	nd	0.07^{ghi}	0.05^{de}	nd	12.52^{bc}	0.36^{d}	0.09^{e}	0.24^{a}	2.77^{e-i}	31.10^{h-m}	50.05^{e-i}	1.33^{i}	0.58^{d-g}	0.33^{f}	0.18^{e-h}	0.06^{m}	0.06^{t}	0.21^{m}	-
AG 9229	0.11^{e}	0.05^{c}	0.04	0.06^{cd}	0.02^{bc}	13.65^{ab}	0.35^{e}	0.10^{c}	0.03^{e}	2.79^{d-h}	29.30^{j-p}	50.46^{e-h}	1.41^{g}	0.66^{b}	0.33^{f}	0.30^{b}	0.04^{n}	0.04^{y}	0.26^{g}	-
AG 9242	nd	nd	0.01^{i}	0.05^{de}	nd	11.95^{bc}	0.29^{k}	0.08^{f}	0.03^{e}	2.29^{o-t}	28.35^{l-p}	54.19^{bc}	1.49^{f}	0.50^{i-l}	0.31^{h}	0.18^{e-h}	0.04^{n}	0.05^{v}	0.19^{o}	-
Mocejan	nd	nd	0.01^{i}	0.05^{de}	0.01^{cd}	12.23^{bc}	0.24^{p}	0.09^{e}	0.04^{d}	2.77^{e-i}	33.85^{c-h}	48.04^{hl}	1.28^{m}	0.59^{def}	0.29^{j}	0.18^{e-h}	0.04^{n}	0.05^{v}	0.24^{i}	-
TTM 815	nd	nd	0.01^{i}	0.05^{de}	0.01^{cd}	12.76	0.34^{f}	0.09^{e}	0.04^{d}	3.00^{cde}	37.11^{abc}	43.54^{n}	1.53^{e}	0.64^{bc}	0.36^{d}	0.19^{d-g}	0.06^{m}	0.06^{u}	0.21^{m}	-
Balkan	nd	0.03^{d}	0.16^{efg}	0.05^{de}	0.02^{bc}	13.51^{ab}	0.31^{h}	0.09^{e}	0.04^{d}	3.02^{cd}	31.45^{g-l}	48.05^{h-l}	0.94^{d}	0.61^{cde}	0.30^{i}	0.21^{c-f}	0.42^{c}	0.50^{d}	0.29^{e}	-
C 955	nd	0.02^{de}	nd	0.05^{de}	0.02^{bc}	11.22^{bc}	0.23^{r}	0.09^{e}	0.04^{d}	2.58^{g-n}	35.22^{b-f}	47.80^{il}	1.06^{z}	0.59^{def}	0.37^{c}	0.22^{cde}	0.22^{d-f}	0.04^{y}	0.23^{k}	-
RX 9292	nd	nd	0.01^{i}	0.04^{ef}	0.01^{cd}	12.74^{b}	0.25^{n}	0.09^{e}	0.04^{d}	2.55^{h-o}	29.78^{j-o}	51.67^{df}	1.39^{h}	0.58^{d-g}	0.27^{l}	0.17^{fgh}	0.07^{lm}	0.11^{o}	0.23^{k}	-
31G98	0.02^{hi}	nd	0.02^{i}	0.04^{ef}	0.01^{cd}	13.17^{ab}	0.26^{m}	0.09^{e}	0.04^{d}	2.40^{l-s}	28.97^{k-p}	52.32^{cde}	1.29^{l}	0.50^{i-l}	0.32^{g}	0.15^{gh}	0.07^{lm}	0.13^{n}	0.20^{n}	-
P 3167	nd	0.01ef	0.09^{f-i}	0.04^{ef}	0.02^{bc}	12.57^{bc}	0.31^{h}	0.11^{b}	0.05^{c}	2.61^{f-m}	37.44^{ab}	43.94^{mn}	1.08^{y}	0.66^{b}	0.39^{a}	0.21^{c-f}	0.07^{lm}	0.07^{s}	0.24^{i}	-
31K61	0.07^{f}	0.05c	nd	0.05^{de}	0.02^{bc}	12.21^{bc}	0.28^{l}	0.10^{c}	0.04^{d}	2.28^{rst}	37.07	45.24^{ln}	0.90^{E}	0.51^{i-l}	0.38^{b}	0.18^{e-h}	0.23^{f}	0.22^{i}	0.17^{p}	-
Vero	0.01^{ij}	0.01ef	0.02^{i}	0.04^{ef}	0.01^{cd}	10.47^{bcd}	0.24^{p}	0.10^{c}	0.04^{d}	3.14^{c}	31.84	51.44^{efg}	1.32^{k}	0.62^{bcd}	0.28^{k}	0.16^{gh}	0.01^{p}	0.02^{z}	0.23^{k}	-
Doge	nd	nd	nd	0.04^{ef}	0.01^{cd}	13.39^{ab}	0.21^{r}	0.10^{c}	0.05^{c}	2.82^{d-g}	33.23^{d-i}	47.10	1.54^{d}	0.61^{cde}	0.34^{e}	0.19^{d-g}	0.08^{l}	0.08^{r}	0.21^{m}	-
Ada 523	0.02^{hi}	nd	0.06^{ghi}	0.04^{ef}	0.02^{bc}	12.78^{b}	0.29^{k}	0.09^{e}	0.04^{d}	2.49^{k-s}	35.62^{a-d}	45.75^{kn}	0.89^{F}	0.64^{bc}	0.36^{d}	0.25^{c}	0.16^{l}	0.20^{k}	0.30^{d}	
Arifiye	0.01^{ij}	nd	0.03^{i}	0.03^{f}	0.01^{cd}	11.21^{bc}	0.21^{r}	0.09^{e}	0.04^{d}	2.60^{f-m}	32.34^{e-k}	51.03^{efg}	1.11^{v}	0.52^{h-k}	0.31^{h}	0.21^{c-f}	0.03^{o}	0.05^{v}	0.17^{p}	
Ada 9510	nd	nd	nd	0.04^{ef}	nd	12.40^{bc}	0.28^{l}	0.09^{e}	0.04^{d}	2.35^{m-t}	31.99^{f-k}	40.10^{o}	1.22^{p}	0.64^{bc}	0.34^{e}	0.24^{c}	0.07^{lm}	0.07^{s}	0.21^{m}	
Ada 9516	nd	nd	0.02^{i}	0.04^{ef}	nd	12.71^{b}	0.29^{k}	0.08^{f}	0.04^{d}	2.50^{k-s}	32.40^{e-j}	49.04^{g-j}	1.21^{r}	0.66^{b}	0.33^{f}	0.23^{cd}	0.04^{n}	0.06^{t}	0.35^{b}	
Mean	0.30	0.06	0.02	0.07	0.01	12.15	0.29	0.09	0.06	2.67	31.86	49.12	1.17	0.06	0.30	0.20	0.15	0.19	0.23	0.08
LSD%5	1.354	1.432	10.101	1.522	1.384	355.738	0.014	0.486	0.677	24.287	338.39	242.870	0.024	4.917	6.45E-3	4.169	1.775	0.243	0.013	ns

TABLE-3
SOME SPECIFIC CHARACTERISTICS OF CORN OILS
OBTAINED FROM DENT CORN VARIETIES

Corn varieties	Saturated oil content (%)	Unsaturated oil content (%)	Iodine number	nD40 ºC
G-626	21.08[a]	78.92[3]	95.89[7]	1.4696[a]
Pegaso	17.48[c]	82.57[1]	113.3[y]	1.4666[a]
VHD	16.76[f]	83.24[y]	118.96[h]	1.4656[ab]
H-2581	14.81[öp]	85.19[i]	118.44[j]	1.4650[ab]
H-2547	18.66[b]	81.34[2]	106.41[6]	1.4721[a]
Trebia	15.42[m]	84.58[n]	122.60[d]	1.4668[a]
Tector	13.82[u]	86.18[c]	125.26[a]	1.4655[ab]
P-3394	16.06[l]	83.94[st]	119.22[g]	1.4646[ab]
AG 92140	17.11[e]	82.89[z]	114.59[ü]	1.4676[a]
Ag 9241	14.88[ö]	85.12[j]	115.51[s]	1.4646[ab]
Trakya 613	13.52[v]	86.48[a]	123.33[c]	1.4657[ab]
OSSK 644	16.18[ij]	83.82[u]	112.59[z]	1.4663[a]
DK-647	15.29[n]	84.71[m]	115.74[p]	1.4637[ab]
Dracma	16.62[g]	83.38[d]	111.81[a]	1.4658[ab]
Brasko	13.68[ü]	86.32[b]	124.53[d]	1.4646[ab]
359P12	13.88[u]	86.12[d]	116.34[p]	1.4661[a]
Gözdem	14.76[pr]	85.24[h]	114.84[u]	1.4671[a]
Karaçay	16.27[hi]	83.73[ü]	109.72[5]	1.4666[a]
TTM 81-19	16.10[ij]	83.90[t]	116.99[m]	1.4663[a]
AG 9229	17.20[de]	82.80[w]	116.01[ö]	1.4660[a]
AG 9242	14.70[r]	85.30[g]	121.86[e]	1.4650[ab]
Mocejan	15.44[m]	84.56[m]	115.35[t]	1.4647[ab]
TTM 815	16.30[h]	83.70[ü]	111.06[3]	1.4638[ab]
Balkan	17.23[d]	82.77[w]	111.49[2]	1.4682[a]
C 955	14.25[s]	85.75[f]	84.27[8]	1.4662[a]
RX 9292	15.73[kl]	84.27[p]	118.35[k]	1.4649[ab]
31G98	16.05[j]	83.95[s]	118.08[l]	1.4640[ab]
P 3167	15.81[kl]	84.19[r]	110.19[4]	1.4661[a]
31K61	15.10[o]	84.90[k]	111.89[w]	1.4669[a]
Vero	14.08[t]	85.92[e]	119.67[f]	1.4660[a]
Doge	16.62[g]	83.38[v]	113.85[v]	1.4665[a]
Ada 523	15.83[k]	84.17[r]	111.65[l]	1.4668[a]
Arifiye	14.23[s]	85.77[f]	118.75[i]	1.4661[a]
Ada 9510	15.20[n]	84.80[l]	116.54[n]	1.4661[a]
Ada 9516 (Hacibey)	15.68[l]	84.32[o]	115.69[r]	1.4645[ab]
Mean	15.77	84.23	114.59	1.4661
LSD% 5	0.092	0.049	0.092	0.0060

of the corn varieties under discussion were found to be considerably rich. Recent studies have suggested that higher levels of this essential fatty acid in the blood reduce the risk of stroke[14]. Infancy and aging are two sensitive and critical periods, where adequate essential fatty acid and PUFA bioavailability is crucial for proper functioning of the brain. PUFA deficiency in both periods has an effect on learning and memory, sensory function and mood[15]. This situation explains that the oils of varieties having rich linoleic acid content are important for human nutrition.

The palmitic acid (C:16) content which is major fatty acid in corn oil changed between 10.47 and 16.78 %. The highest C:16 content was determined in variety G-126 and this variety had the highest saturated fatty acid content. On the other hand, Vero variety showed the lowest C:16 content (10.47 %) and this oil was one of the oils that was highly unsaturated and rich in linoleic acid content (Table-2). The ratio of stearic acid (C 18:0) of corn oils varied from 2.29 to 3.68 %. Present results were agreement with findings of Park *et al.*[16] and Koçak[17].

C6:0 (Caproic acid) and C8:0 (caprilic acid) which are saturated fatty acids were determined in minor levels in some of corn oils while most of corn oils did not comprise them. C6:0 and C8:0 changed between 0.01 and 0.96 %, 0.01 and 0.29 %, respectively. The highest ratios of these fatty acids were found in variety VHD while these fatty acids were not determined in variety H-2581 having the highest oil content. C10:0 (capric acid) ranged from 0.01 to 0.62 % in most of oils but, it was not obtained in some of them. The highest C10:0 content was found in Gözdem variety. The fatty acids of C 17:0, C17:1, C 20:0, C 20:1, C22:0, C 22:1 and C22:2 were determined lower than 1 % (Table-2).

The grain yield in the corn varieties changed between 1099.32-796.32 kg/da. The highest grain yield was obtained in variety Dracma, Dk 647 and Ada 9516 and corn varieties Ag 9229, H-2581 and Brasko in respect to grain yield were followed these varieties. On the other hand, corn Arifiye variety showed the lowest grain yield in the varieties.

In this study, intervarietal comparison of results showed that the nutritional components were significantly different. In previous studies, some researchers reported that the chemical composition and nutritional value of maize are variable and depend on the variety, growing conditions, starch structure, oil and protein content[18-20]. Crude protein was determined as 8.1-10.5 and 8.8-9.2 % in the popcorn hybrids by some researchers[10,16]. Protein content of Ag 9241 variety and Arifiye variety were showed similar results with these researchers. Recent studies on hybrids have generally indicated that protein content was controlled by mainly genetic factors than environmental factors such as planting date, location and year[21].

The ferrous and potassium content of corn varieties were found similar to while the ash content was lower than reported of Kirtok[2]. Present results about ferrous content of corn were showed good agreement with to previous report[22].

Park *et al.*[16] obtained that the content of crude oil as 3.8-4.6 % and Vyn and Tollenaar[23] also reported that the lipid concentrations ranged from 3.38 to 3.95 %. As it is seen from the result given above that variation in content of crude oil was found to be higher than that of these studies.

Iodine value (IV) is a measure of overall unsaturation and is widely used to characterize oils and fats[24]. The variety of number Tector, Brasko and Trakya 613 were found the higher iodine value content than other varieties and the results of

iodine value showed parallelism with saturated and unsaturated fatty acid content of oils. United States Food and Drug Administration[3] reported that the iodine value of refine corn oils as 102-130. Present results (110-120) were found agreement with their reports however variety G-126 was found different due to high saturated fatty acid content.

Linoleic acid content of varieties was found different each other but significant level. Park *et al.*[16] determined that the major fatty acids in the popcorn hybrids were linoleic acid and oleic acid and which are contained in popcorn hybrids an average *ca.* 12.6 % palmitic acid, 2.0 % stearic acid, 25.5 % oleic acid, 58.4 % linoleic acid and 1.5 % linolenic acid. The linoleic acid, oleic acid and linolenic acid contents of corn oil were reported as 61.9, 24.1 and 0.7 %, respectively by Kirtok[2]. On the other hand, Koçak[17] determined similar results as linoleic acid 59 %, oleic acid 27 %, palmitic acid 12 %, stearic acid 2 %, linoleic acid 0.8 % and arashidonic acid 0.2 %. Present findings were lower linoleic acid, higher oleic acid content as compared to results given above. G-626 variety had the higher saturated fatty acid (SFA), palmitic acid and oleic acid (MUFA) content than the other varieties and therefore oil could be more suitable for frying than other varieties oil due to higher saturated fatty acids and oleic acid content. According to Thomison *et al.*[25] in the future, corn oil rich in palmitic acid may be in demand for margarine production, requiring less chemical processing whereas cooking oils derived from corn high in oleic acid would be beneficial to consumers' health. In addition, the increase in oleic acid (*cis* 18:1) content of corn oils is suitable for frying from than decrease in peroxide levels and it has been interesting for the fast food industry in the recent years. The C:16 content in corn oils were found similar with founding in Park *et al.*[16].

From the present study, it can be concluded that H-2581 variety and Ag 9241 variety were found to be rich in oil a protein content among the varieties. Corn varieties H-2581, Brasko and 359P12 having highest oil content were found the second groups in respect to grain yield. Dracma, DK-647 and Ada 9516 varieties gave the highest grain yield, but these vatieties for oil content were ranked the lowest groups. Additionally, corn varieties studied in this research were considerably rich in linoleic acid content. The oils of varieties which are rich in linoleic acid content are of great importance for human nutrition. Only variety G-626 was found comprising higher saturated fatty acid, palmitic acid and oleic acid contents. Increase in oleic acid (*cis* 18:1) content of corn oils is suitable for frying than decrease in peroxide levels and it has been interesting for the fast food industry. The results of this study will be lighted to improve of corn varieties having high linoleic acid and oleic acid in future studies. The varieties which are rich in other important components such as protein and oil will be reference to studies to be carrying out in future, especially in regarding human and animal food.

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