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EFFECT OF SUNFLOWER SEED VARIETIES ON THE CHEMICAL COMPOSITION, MINERALS CONTENT, OIL CHARACTERISTICS AND FATTY ACID COMPOSITION

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ABSTRACT

The present study was carried out to investigate the chemical composition and oil characteristics of seeds from some Egyptian sunflower varieties and hybrids namely: Hybrid ١٠٢, Euroflor and Vidok. The following topics were covered: (a) chemical composition of whole sunflower seeds and kernels from different varieties, (b) physical properties and chemical characteristics of resulting crude oils and (c) fatty acid composition and unsaponifiable matters of oil samples by GLC. The result obtained showed a relation between the size of achen and the weight of ١,٠٠٠ seed. The hull and kernel ratio depends on the seed variety, maturity state and pedo-climatic conditions. Furthermore there is an invers correlation between oil and protein content in the case of whole seed and kernel . The samples of Hybrid (١٠٢) had the highest value in minerals content (P , K ,Mg , Na ,Zn , C u , Fe and Ca) while the lowest value in mineral content was found in seeds of Euroflor variety . It can be pointed out that the oil content of seed is the most important factor which controls the total composition. The increase of oil content is accompanied by increase in linoleic acid content. On the other hand it was noticed a linear relationship between the iodine value (I.V.) and Linoleic acid (C١٨:٢) content. Whereas, an inverse relationship was recorded between Oleic acid (C١٨:١) and Linoleic acid (C١٨:٢) . The high oil varieties of sunflower are characterized by a predominance of

Linoleic acid (C١٨:٢) over Oleic acid (C١٨:١) . The percentage of hydrocarbon were found to be ٢١.٤١٪ , ٣٠.٥١٪ and ٤٧.٠٤٪of unsaponifiable matter for Euroflor , Vidok and Hybrid (١٠٢) respectively.Where total sterol ranged from ٥٢.٩٦٪ to ٧٨.٥٩٪ of the unsaponifiable matter. Whereas fraction β-stosterol was the major sterol followed by stigmasterol and campsterol.

INTRODUCTION

Oil seeds are widely used for the production of vegetable oils and the remainder meals are rich in protein dietary, fibers and carbohydrates. The major parts of oil seed meals are consumed by animal and poultry feeding. Besides, large amount of edible oils used in socalled convenience food such as potato chips, roasted nuts, popcorn and many others. From the nutritional point of view, oils and fats are a structural component of the membranes, which enclose living cells. (Swern, ١٩٧٩ and Lawson, ١٩٩٥)

In Egypt, the production of vegetable oils is not sufficient to provide the people with edible oils. The country's policy is directed towards increasing domestic production of different oil crops to overcome being largely dependant on imports of edible oils. Attempts are given to improve the cropping pattern, intensify the cropping system, reclamation and cultivation of desert lands, improvement, development of irrigation water and increasing availability of high seed quality together with agricultural imputes at fair prices Iskander et al., (١٩٨٦),and (١٩٨٩).

The sunflower seed may be dehulled and eaten without processing. The dehulled seed may be roasted in oil and salted, or used as nutmeats and in candy, salads and bakery products Robertson, (١٩٧٢).

Sunflower oil is a high quality oil for cooking and salad oil uses. In Europe, it has been used extensively in shortening and margarine. The oil is unusually good for frying foods, where a liquid oil with high smoke point is desired. In addition, sunflower oil with higher levels of Linoleic acid, i.e., highly polyunsaturated, is desired for the soft margarine and coating industries, (UNIDO, ١٩٧٧ and Egan et al., ١٩٨١). Traditional sunflower varieties

generally produce oils which have high levels of Linoleic acid and low level of oleic acid, characteristics which have been associated with health problems. To overcome these negative health associations, newer sunflower varieties have been developed with different oil compositions (Honda et al., ٢٠٠٥).

The present work was carried out on some new sunflower seeds varieties namely : Vidoc , Euroflor and hybrid ١٠٢ in an attempt to study the following points: (a) the gross chemical composition of whole sunflower seeds and kernels , (b) the physical properties ,chemical characteristics , fatty acid composition and the minor constitutes of the crude oil extracted from sunflower seeds.

MATERIALS AND METHODS

Materials:-

Sunflower seeds:-

Three different new varieties and hybrids of sunflower seeds namely: Hybrid ١٠٢, Euroflor and Vidok were selected in this investigation and obtained from the Field Crops Research Institute, (FCRI), Agriculture Research center (ARC) at Abnob-Assiut, Egypt.

Sunflower seeds oil:-

Sunflower oil samples were extracted from the studied seeds by using pure n-hexane according to the method described in **AOCS (١٩٩٨).** The oil was dried over anhydrous sodium sulfate, filtered, stored in dark brown bottles then kept at ٥ ºC until analysis.

Analytical methods:-

Analysis of sunflower seeds:-

Moisture ,crude oil , crude protein (T.N.x ٦.٢٥) , crude fibre and ash were determined according to the method of the AOAC (٢٠٠٠).

Total carbohydrates were estimated (as glucose%) after acid hydrolysis and spectrophotometrically determined using phenol, sulphoric acid reagent according to the method of Dubois et

al.,(١٩٥٦). All determinations were performed triplicates and the means were reported.

Minerals contents phosphorus (P) , potassium (K), magnessium (Mn), sodium (Na), zinc (z), cupper (Cu), iron (Fe) and calcium (Ca) were determined according to the methods described in AOAC (٢٠٠٠). Calcium and magnesium contents were determined using Double Beam Atomic Absorption .Potasium and sodium contents were determined by flam photometer method , Coring ٤١٠ (coring Limited Halested Essex England UK) Iron and zink were determined by spectrophotometry ٩٠٢ GBC and phosphorus by using visible spectrophotometer PU ٨٦٥٠ (Pye Unicam , England).

Analysis of sunflower seed oil:-

Physical properties:-

All the samples were analyzed according to the **AOCS (١٩٩٨),** the Specific gravity (Sp.Gr.) for sunflower seed oil samples was determined at ٢٥/٢٥^{o}C according to Cc ١٠-٢٥, the refractive index (R.I.) was tested according to Cc٧-٢٥ and the color of oil samples was determined by the color Wesson method using Lovibond glasses and calibrated according to Cc ١٣b-٤٥.

An automatic refractometer was used and the results were standardized at ٢٥^{o}C.

Chemical Characteristics:-

The investigated samples was examined according to the method described in the AOCS (١٩٩٨) ,the acidity of the samples was examined according to Cd-٣a-٦٣ and was calculated in terms of acid value (A.V) as mg. KOH / g. oil sample, the iodine value (I.V) was determined by the Hanus method as described in the Cd ١-٢٥,the saponification value (S.V.) was investigated as outlined in the Cd ٣-٢٥, and peroxide value (P.V.)as mg of koh/ saponify ١g oil was tested according to Cd٨-٥٣. The PV was reported as milliequvalents of peroxide per Kg sample.

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Unsaponifiable matters of oil:-

Separation of unsaponifiable matters:-

The unsaponifiable matters were separated from the oil samples after saponification according to the method outlined in the AOCS (١٩٩٨).

Identification of the unsaponifiable matters components by gas liquid chromatography :-

The unsaponifiable matters (hydrocarbons and sterols compounds) were identified by using a Hewlett Packard gas chromatography model ٥٨٩٠ equipped with a flame ionization detector in the presence of nitrogen as carrier gas. The separation was carried out at ١٠٠-٢٨٠ ºC (temperature rate ٥ºC/min.) followed by ٢٠min. at ٢٨٠ ºC. The column used for separation was ٢٥ x ٠.٢ m L.D. fused silica capillary column coated with dimethyl silicon fluid. The injector and detector temperatures were ٢٥٠ and ٣٠٠ ºC, respectively. The nitrogen, hydrogen and air flow rates were ٢٠, ٣٠ and ٤٠٠ ml/min., respectively. The sample size was ١µL. The authentic samples of hydrocarbons (C١٢ ; C١٣ ; C١٤ ; C١٥ ; C١٦ ; C١٧; C١٨;C١٩; C٢٠ ; C٢١ ; C٢٢; C٢٣ ; C٢٤ ; C٢٥ ; C٢٦;٢٧ ; C٢٨; C٣٠ and squalene) and sterols (cholesterol, campestrol, stigmasterol and B-sitosterol) were also injected under the same conditions and the relative retention times (R.R.T) were calculated. The peaks area were identified by comparing their retention times with those of standardized under the same conditions. Retention times were deermined by using Hewlett Packared ٣٣٩٢ integrator.

Fatty acid compositions:-

The composition of the fatty acid s was performed by gas liquid chromatography (GLC) . The methyl esters of fatty acids were prepared as described in AOCS (١٩٩٨).

The fatty acid methyl esters were separated by using a Hewlett Packard GLC (model ٥٨٩٠) equipped with a dual flam ionization detector (FID). The coiled glass column (١.٦m × ٤mm) was packed with diatomite (٠٠-١٢٠ mesh) and coated with ١٠٪ Di–ethylglyco succinate (DEGS). The operation was carried

isothermally at column temperature ١٧٠ºC, detector and injection temperatures were ٣٠٠ºC and ٢٥٠ºC, respectively. The nitrogen, hydrogen and air flow rates were ٣٠, ٣٠ and ٣٣٠ ml. /min., respectively. The sample size (١μL) of fatty acid methyl esters were dissolved in chloroform was injected into the column using a Hamilton microsyring. chart speed was ٢ cm./ min. Peak areas were measured using Hewlett Packared ٣٣٩٢ integrator.

RESULTS AND DISCUSSION

Chemical composition of sunflower seeds :-

١-Gross chemical composition of whole seed (achene):-

The major components of whole sunflower seeds (achene) and kernels of Hybrid (١٠٢), Euroflor and Vidok were studied. Weight of ١٠٠٠ seeds, % kernel, % hull, % ash, % oil, % protein, % fiber and % of carbohydrates were determined and the results are shown in Tables (١) and (٢). The results represented in this study Table (١) indicated that the weight of ١٠٠٠ seeds was ٤٣.١٠g. for Hybrid (١٠٢), ٥٢.٠٠g. for Euroflor and ٥٦.٣٠g. for Vidok. The differences in the weight of ١٠٠٠ seeds may be due to the variations in the degree of seed development and the cultivation zone .On the other hand, these differences could be explained by the fact that for achenes of oilseed varieties exist a relationship between the size of achene and weight of ١٠٠٠ seeds. Such results are in reasonable agreement with those of, Earle, et al.,(١٩٦٨)) Biino and Carlisi,. (١٩٦٩).and Eskandar, and Banu, (١٩٨٢). .As for the kernel percentage of different varieties and hybrids, the data obtained in Table (١) indicated that the kernel percentage was ٧١.٢٠, ٧١.٤٤ and ٧٤.٠٠ for Hybrid (١٠٢); Vidok and Euroflor, respectively. On the other hand, results in Table (١) showed the following values for hull percentage: ٢٦.٠٠; ٢٨.٥٦ and ٢٨.٨٠ for Euroflor, Vidok and Hybrid (١٠٢), respectively.These results revealed that both percentage of kernel and hull depended on the seed variety, the stage of maturity, the cultivation zone and the purpose of seed production (for confections and birdseed or oil). Such results agree with those reported by Biino and Carlisi,.

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(١٩٦٩). , Eskandar, and Banu, (١٩٨٢). and Raymond,et al.,(١٩٩١). Furthermore, the data in Table (١) indicated that the moisture content was ٤.٨٣, ٤.٧٠ and ٤.١٨ % in Hybrid (١٠٢), Euroflor and Vidok, respectively. Also, the results in the same Table showed that the dry matter percentage for the studied varieties and hybrids was ٩٥.١٧ , ٩٥.٣٠ and ٩٥.٨٢ % in Hybrid (١٠٢); Euroflor and Vidok , respectively. These results are in the same trend with those reported by (Darwish,et al.,(١٩٧٥),Hafiz ,et al.,(١٩٩٣), and Francis,(٢٠٠٠).As for ash content, the results represented in this study (Table, ١) showed a little variation in the ash content between different varieties and hybrid. The following values were found: ٤.٢٥; ٤.٢٨ and ٤.٤٠ % (on DB) for Hybrid (١٠٢), Euroflor and Vidok, respectively. Similar results were obtained by Pellet, and Shadarevian, (١٩٧٠).

Table ١: Proximate chemical composition (*) of whole sunflower seeds (achene) of three cultivars

Analysis		Variety and hybrid		
		Hybrid (١٠٢)	Euroflor	Vidok
Weight of ١٠٠٠ seeds, (g) (**)		٤٣.١٠	٥٢.٠٠	٥٦.٣٠
Kernel, %		٧١.٢٠	٧٤.٠٠	٧١.٤٤
Hull, %		٢٨.٨٠	٢٦.٠٠	٢٨.٥٦
Moisture %		٤.٨٣	٤.٧٠	٤.١٨
Dry matter %		٩٥.١٧	٩٥.٣٠	٩٥.٨٢
Ash %	W.B	٤.٠٤	٤.٠٨	٤.٢٢
	D.B	٤.٢٥	٤.٢٨	٤.٤٠
Oil %	W.B	٤١.١٦	٣٨.٩٧	٤٤.٧٤
	D.B	٤٣.٢٥	٤٠.٨٩	٤٦.٦٩
Protein (N x ٦.٢٥), %	W.B	٢٣.٤٤	٢٥.٨٨	١٦.٠٢
	D.B	٢٤.٦٣	٢٧.١٦	١٦.٧٢
Fiber %	W.B	١٨.١٤	١٧.١٣	٢٣.٥٢
	D.B	١٩.٠٦	١٧.٩٧	٢٤.٥٥
Carbohydrates as glucose % (***)	W.B	٨.٣٩	٩.٢٤	٧.٣٢
	D.B	٨.٨١	٩.٧٠	٧.٦٤

(*) Each figure give in this Table is a mean of three determinations.

(**) Calculated from weight of kernel and hull, to avoid inclusion of empty or wormy achens.

(***) Including soluble and non-soluble sugars.

On the basis of total oil content, it was observed the following values: ٤٣.٢٥, ٤٠.٨٩ and ٤٦.٦٩ % (on DWB) for whole, sunflower seeds (achene) of Hybrid (١٠٢), Euroflor and Vidok, respectively. Generally, it can be observed that all the studied sunflower seed varieties had high oil content ranging from ٤٠.٨٩ and ٤٦.٦٩ % (on DB). These results are in accordance with those reported by, Morrison,(١٩٨٣) and Fadia,(٢٠٠٤) . Concerning the protein content (DB), the studied varieties and hybrids can be arranged in the following ascending order : Vidok (١٦.٧٢ %) ; Hybrid-١٠٢ (٢٤.٦٣ %) and Euroflor (٢٧.١٦ %). These results show the existence of an inverse relationship between oil content and protein content. Such results are in good accordance with those recorded by, Pellet, and Shadarevian, (١٩٧٠) Robertson, et al., (١٩٧١), Morrison,(١٩٨٣) , Praveena, et al., (٢٠٠٠) and Fadia (٢٠٠٤).

As for the fiber content (DB) in different sunflower varieties and hybrids used in this study, it was noticed from Table (١) that the fiber content (DB) in whole sunflower seeds ranged from ١٧.٩٧ % (in Euroflor variety) to ٢٣.٥٢ % (in Vidok variety). This difference in fiber content could be attributed to variations in the seed varieties which detemine hull proportion and the fiber content. These results are in general agreement with those reported by Francis,(٢٠٠٠).The carbohydrate contents (soluble and nonsoluble sugars) were: ٨.٨١ % (on DB for Hybride, ١٠٢); ٩.٧٠ % (for Euroflor variety) and ٧.٦٤ % (for Vidok variety) (Table, ١). Such results are in the same trend with those reported by Fadia (٢٠٠٤)

٢- Gross chemical composition of sunflower seed kernel:-

Data in Table (٢) indicated that the sunflower seed kernel of Vidok variety had the highest value of moisture content (٥.٤٧ %) followed by Hybrid (١٠٢) ٣.٩٤ % whereas the lowest value of moisture content was found in Euroflor variety (٣.٠٣ %). In addition, the data recorded in Table (٢) revealed that the dry matter

was ranged between ٩٤.٥٣ % for Vidok variety to ٩٦.٩٧ % for Euroflor variety. These results are in the same trend with those reported by Hafiz, et al., (١٩٩٣).

As for ash content, the results obtained in Table (٢) show that the ash content (DB) of sunflower seeds kernel varities was in the range of ٤.٦٧ % (for Euroflor variety) and ٥.٨٠ % (for Hybrid, ١٠٢) with a mean of ٤.٧٤ %. These results are in coincide acne with those obtained by Saeed and Cheryan, (١٩٨٨). . On the basis of oil content (DB), the following values were noticed: Hybrid, ١٠٢ (٤٦.٩١ %), Euroflor (٤٢.٤٨٪) and Vidok (٥١.٢٤ %). On the other hand, it was observed the following values for the protein content: ٢٣.٩٢ %, ٢٩.٦٩ % and ١٤.٦٤ % (on DB) in Hybrid (١٠٢), Euroflor, and Vidok, respectively. Such results agree with those reported by Pellet, P. L. and Shadarevian, S. (١٩٧٠).

As for fiber content (DB), the following results were obtained : Hybrid-١٠٢ (١٦.١٧ %); Euroflor (١٥.٤٨ %) and Vidok (٢٢.٥٨ %). Such findings agree with those reported by Bau, et al., (١٩٨٣) . Concerning the content of carbohydrates (DB), the results represented in Table (٢) showed the following values: Hybrid-١٠٢ (٧.٢٠ % on DB); Euroflor (٧.٦٨ %) and Vidok (٦.٢٨ %). These results are in general agreement with those recorded by. Hafiz,Et al.,(١٩٩٣) and Fadia (٢٠٠٤).

Table ٢: Proximate composition (*) of sunflower seeds kernel of three cultivars

Analysis		Variety and hybrid		
		Hybrid (١٠٢)	Euroflor	Vidok
Moisture %		٣.٩٤	٣.٠٣	٥.٤٧
Dry matter %		٩٦.٠٦	٩٦.٩٧	٩٤.٥٣
Ash %	W.B	٥.٥٧	٤.٥٣	٤.٩٧
	D.B	٥.٨٠	٤.٦٧	٥.٢٦
Oil %	W.B	٤٥.٠٦	٤١.١٩	٤٨.٤٤
	D.B	٤٦.٩١	٤٢.٤٨	٥١.٢٤
Protein (N x ٦.٢٥), %	W.B	٢٢.٩٨	٢٨.٧٩	١٣.٨٤
	D.B	٢٣.٩٢	٢٩.٦٩	١٤.٦٤
Fiber %	W.B	١٥.٥٣	١٥.٠١	٢١.٣٤
	D.B	١٦.١٧	١٥.٤٨	٢٢.٥٨

Carbohydrates % (**)	**W.B**	٦.٩٢	٧.٤٥	٥.٩٤
	D.B	٧.٢٠	٧.٦٨	٦.٢٨

(*) Each figure give in this table is a mean of three determinations.
(**) Including soluble and non-soluble sugars.

٣ – Mineral content of sunflower seeds :-

The minerals content, i.e. P, K, Mg, Na, Zn, Cu, Fe and Ca, in the three cultivars of sunflower seeds (whole seeds and kernel) were determined and the results are embodied in Tables (٣) and (٤). Generally, it can be observed that the samples of Hybrid-١٠٢ (either whole seeds or kernel) had the highest value of all determined minerals followed by samples of Vidok and the lowest values were found in Euroflor samples. Concerning phosphorus (p), the results recorded in Tables (٣) and (٤) indicated that it ranged between ٧٣٠.٠٠ and ١٩٠٠.٠٠ mg / ١٠٠g for achene and between ٧٠٠.٠٠ and ٧٣٠.٠٠ mg / ١٠٠g for sunflower seed kernel. These results are in coincid with those obtained by Ndoreyaho, et al., (١٩٩١), and Ensminger,et al., (١٩٦٥) but they were higher than those reported by Hafiz et al (١٩٩٣) This differences might be due to variation in the seed variety, stage of maturity and the cultivation zone. Regarding the potassium element (K), it was evident from the results in Tables (٣) and (٤) that it represented the predominant inorganic constituent in sunflower seeds. These results are in the same trend with those reported by Watt and merill (١٩٧٥).

Table ٣ : Mineral content of whole sunflower seeds (achene) of three cultivars (mg /١٠٠g)*

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Minerals / Varietes	P	K	Mg	Na	Zn	Cu	Fe	Ca
Hybrid –١٠٢	١٩٠٠.٠٠	٢٨٦٠.٠٠	١١٨٠.٠٠	١٧٨.٩٠	١٢.٨٠	١.٦٣	١.١٨	٣٦.٦٠
Euroflor	٧٣٠.٠٠	١٥٣٠.٠٠	١١٧٠.٠٠	.٠٠	٨.٩٠	٠.٦٩	٠.٥١	٣٣.١٠
Vidok	٧٥٠.٠٠	٢٨٢٠.٠٠	١١٧٥.٠٠	١٧٦.٣٠	١١.٠٠	١.٠٤	١.٠٨	٣٤.٥٠

*Results are the mean of triplicate determinations and calculated on DB.

This differences could be attibuted to the seed variety as weel as cultivation zone. With regard to other minerals i.e. magnesium, sodium, zink, cupper, iron and calcium, in the whole sunflower seeds (achene) , the results in Table (٣) showed the following values: magnesium (١١٧٠ - ١١٨٠ mg / ١٠٠g), sodium (١٦٦.٠٠ - ١٧٨.٩٠ mg / ١٠٠g) , zinc (٨.٩٠ - ١٢.٨٠ mg / ١٠٠g) ; cupper (٠.٦٩ - ١.٦٣ mg / ١٠٠g); iron (٠.٥١ -١.١٨ mg / ١٠٠g) and calcium (٣٣.١٠ - ٣٨.٦٠ mg / ١٠٠g) . For sunflower seed kernel samples, the data in Table (٤) showed the following values: magnisum (٩٧٠ - ١٠٦٠ mg / ١٠٠g) ; sodium (١٤٠ -١٥٤ mg / ١٠٠g); zinc (٨.٦٠ - ١٢.٠٠ mg / ١٠٠g) ; cupper (٠.٦٠ - ١.٠٩ mg / ١٠٠g) ; iron (٠.٣٣ -٠.٤٦ mg / ١٠٠g) and calcium (١٥.٨٦ -٢٧.٨٠ mg / ١٠٠g) . Similar results were obtained by Watt, and. Merill, (١٩٧٥) and Ndoreyaho,et al., (١٩٩١).

It is noteworthy to mention that the sunflower seeds can be considered as a good source of minerals and for this reason the sunflower meal can be used in animal nutrition. These results are in the same trend with those reported by Ensminger, et al., (١٩٦٥). They reported that sunflower meal can be considered as a good source of calcium and phosphorus and it contained ٣١ % more than the normal source of iron .

Table ٤ : Mineral content of sunflower seeds kernel of three cultivars (mg /١٠٠g)*

Minerals / Varietes	p	K	Mg	Na	Zn	Cu	Fe	Ca
Hybrid –١٠٢	٧٣٠.٠٠	٢١٩٠.٠٠	١٠٦٠.٠٠	١٥٤.٩٠	١٢.٠٠	١.٠٩	٠.٤٦	٢٧.٨٠
Euroflor	٧٠٠.٠٠	١٥٠٠.٠٠	٩٧٠.٠٠	١٤٠.٠٠	٨.٦٠	٠.٦٠	٠.٣٣	١٥.٨٦
Vidok	٧٢٠.٠٠	١٧٧٠.٠٠	١٠٥٠.٠٠	١٤٧.٣٠	٨.٩٠	٠.٩٠	٠.٣٨	٢٥.٣٠

*Results are the mean of duplicated determinations and calculated on DB.

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Physico-chemical characteristics of crude oil extracted from different varieties of sunflower seeds:-

The physico-chemical characteristics of the sunflower seed oil extracted from different varieties and hybrids are presented in Table (٥). The results obtained indicated that the specific gravity at ٢٥ /٢٥ ºC ranged from ٠.٩١٧٠ (Euroflor) to ٠.٩١٧٦ (Hybrid –١٠٢) with an average of ٠.٩١٧٣. On the basis of refractive index at (٢٥ ºC), the following values were found: Euroflor (١.٤٧٣٥); Vidok (١.٤٧٣٩) and Hybrid –١٠٢ (١.٤٧٣٢). Such results are in reasonable agreement with those obtained by Fadia,(٢٠٠٤). Oil color is another indicator of quality. The results obtained in this study (Table ٥) indicated that the color of oil extracted from Vidok variety was darker (higher) than the color of the other oil samples. This difference of the color is due to the natural pigment content which passes from oil bearing material into the extracted oils, as well as due to the secondary pigments which presence is due to the treatment condition of the bearing material. Seed stored for prolonged periods under unfavourable temperature and moisture conditions and exposed to air- oxidation yields darker colored oils than fresh seed.These results agree with those reported by Rich (١٩٦٧).

On the basis,the acid value, the data in Table (٥) indicated that the acid value (mg KOH / g oil) of laboratory extracted oils was in the range of ٠.٣١ (Euroflor variety) and ٠.٩٣ (Hybrid-١٠٢) with a mean of ٠.٦٢. The differences in acid value may be due to the conditions during ripening of the seeds and conditions of harvesting and storage as well as conditions during processing. Similar results were obtained by Swern,(١٩٧٩), Concerning the iodine value (g iodine saturate ١٠٠g oil), the results obtained in Table (٥) indicated that the iodine value of sunflower oil samples under investigation were ١١٤.١٣; ١٠٣.٤٦ and ١١٨.٥٤ for Euroflor, Vidok and Hybrid (١٠٢), respectively. This is to be expected since the high iodine value could be attributed to the high content of linoleic and linolenic. Generally, it can be observed that the variation in iodine value could be attributed to the variation in

polyunsaturated fatty acid contents. These results are in accordence with those reported by Fadia,(٢٠٠٤). As for the saponification value (mg KOH saponify g oil), results in Table (٥) revealed that the sunflower seed oil extracted from Euroflor variety gave the highest saponification value (١٩٢.٠٠) while, the lowest value (١٨٨.٠٠) was recorded for sunflower seed oil extracted from Vidok variety. These differences could be attributed to the formation of new fatty acids that differ in their molecular weight. In general, the high saponification value indicates lower molecular fatty acids. These results are in harmony with those reported by Weiss (١٩٧٠) and Francis (٢٠٠٠).

Table ٥: Physico - chemical characteristic of crude sunflower oils extracted from different varieties and hybrids .

Characteristic	Variety and hybrid		
	Euroflor	Vidok	Hybrid (١٠٢)
Specific gravity at ٢٥ / ٢٥°C (Sp. Gr.)	٠.٩١٧٠	٠.٩١٧٤	٠.٩١٧٦
Refractive index at ٢٥°C (R. I.)	١.٤٧٣٥	١.٤٧٣٩	١.٤٧٣٢
Color : Lovibond (Y / R), ١ inch cell	٣٥ / ٤.٣	٣٥ / ٦.١	٣٥ / ٥.١
Acid value (A.V.)	٠.٣١	٠.٥١	٠.٩٣
Iodin value (Hanus),(I.V).	١١٤.١٣	١٠٣.٤٦	١١٨.٥٤
Saponification value (S.V).	١٩٢.٠٠	١٨٨.٠٠	١٩١.٠٠
Peroxide value (P.V.).	٠.٧٥	١.١٥	١.٢٣
Unsaponifiable matter (%)	١.١٠	١.٠٢	٠.٩٧

* Each figure given in this table is a mean of three determination.

Oxidative rancidity is the principal problem in fats and oil, peroxide value (as indicator of primary oxidation) is employed in this study to determine the extent of oxidation caused in the investigated oils. Data in Table (٥) indicated that the peroxide value was ٠.٧٥, ١.١٥ and ١.٢٣ meq peroxide /kg sample in Euroflor, Vidok and Hybrid (١٠٢) oil samples, respectively. The results indicated also that the peroxide values of all oil samples used in this study were below the permissible limits of ١٠

milliequivalent of peroxide / kg sample according to E.O.S (١٩٩٣). The unsaponifiable matter (includes hydrocarbons, sterols, vitamins and pigments compounds) usually plays an important role in the oil stability. It is obvious from the results in Table (٥) that the oil samples under investigation had comparable content of unsaponifiable matter (١.١٠ %, ١.٠٢ % and ٠.٩٧ % for oil samples extracted from Euroflor, Vidok and Hybrid –١٠٢, respectively). These finding are in the same line with those reported by Van Oss (١٩٧٥) .

Fatty acid composition:-

The results presented in Table (٦) demonstrated the fatty acid composition of sunflower oil extracted from different varieties and hybrids. The data obtained by using G.L.C. pointed that the major fatty acids were oleic and linoleic which represented ٣٧.٤٠ – ٤٨.٥٨ % and ٣٤.٩٧ – ٤٩.١٦ %, respectively, followed by palmitic acid (٧.٨٤ – ٩.٥٣ %), stearic acid (٣.٥٢ – ٤.٥٥ %), arachidic acid (٠.٢٢ – ١.٤٣ %), behenic acid (٠.٦٥ – ٠.٨٣ %) and linolenic acid which it ranged between ٠.٤١ % and ٠.٤٥ %. In addition, the data given in Table (٦) indicated that the total amount of saturated fatty acids (TSFA) ranged between ١٣.٠٣ and ١٦.٠١ % while the total amount of unsaturated fatty acids (TUFA) ranged from ٨٣.٩٩ to ٨٦.٩٧ %. These results obtained herein are in general accordance with those reported by Osorio,et al.,(٢٠٠٦). Generally, it can be concluded from the results in Table(٦) that: Vidok variety contains the highest percentage of oleic acid (٤٨.٥٨ %), while Euroflor variety contains the lowest percentage (٤١.٥٢ %). Hybrid (١٠٢) contains the highest percentage of linoleic acid (٤٩.١٦ %) while, Vidok variety contains the lowest percentage (٣٤.٩٧ %).There were little differences in amounts of palmitic acid and stearic acid between the investigated oils. Small percentages of arachidic, behenic and linolenic acids were present in the examined seed oils. Sunflower Hybrid (١٠٢) contains the lowest percentage of total saturated fatty acids (١٣.٠٣ %) while Vidok variety contains the highest percentage (١٦.٠١٪). On the other hand, Vidok variety contains the lowest percentage of TUFA (٨٣.٩٩ %) while, Hybrid (١٠٢)

contains the highest percentage (٨٦.٩٧ %).In general, there was a wide variation among the fatty acids contents specially oleic and linoleic acids in all varieties and hybrids of sunflower. These differences may be due to the origin of varieties, the genetic diversity, the stage of maturity, the cultivation zone and the purpose of seed production (for confections and birdseed or oil). Such results agree with those reported by Biino, and Carlisi, (١٩٦٩) and Fadia, (٢٠٠٤).

Table ٦: Fatty acid composition of sunflower seed oil extracted from different varieties and hybrids (% of total fatty acids)

Fatty acids %	Varieties and hybrid		
	Euroflor	Vidok	Hybrid–١٠٢
Saturated fatty acids (SFA)			
Palmitic $C_{16:0}$	٧.٨٤	٩.٥٣	٨.٣٣
Stearic $C_{18:0}$	٤.٥٥	٤.٢٨	٣.٥٢
Arachidic $C_{20:0}$	٠.٢٢	١.٤٣	٠.٥٣
Behenic $C_{22:0}$	٠.٨٣	٠.٧٧	٠.٦٥
Total saturated fatty acids (TSFA)	١٣.٤٤	١٦.٠١	١٣.٠٣
Unsaturated fatty acids (UFA)			
Oleic $C_{18:1}$	٤١.٥٢	٤٨.٥٨	٣٧.٤٠
Linoleic $C_{18:2}$	٤٤.٥٩	٣٤.٩٧	٤٩.١٦
Linolenic $C_{18:3}$	٠٠.٤٤	٠٠.٤١	٠٠.٤٥
Total unsaturated fatty acids (TUFA)	٨٦.٥٦	٨٣.٩٩	٨٦.٩٧
TUFA : TSFA	٦.٤٤	٥.٢٥	٦.٦٧
$C_{18:2} : C_{18:1}$	١.٠٧	٠.٧٢	١.٣١

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any investigations Mc–Gandy, and Egsted, (١٩٧٥) and Vergroesen, and Gottenbos, (١٩٧٥) reported that the diet which has a high

content of linoleic acid and low content of saturated fatty acids play an important role in preventing or inhibition of atherosclerotic disease by lowering the blood cholesterol effect. In addition, FAO / WHO (١٩٧٧) reported that the high content of linoleic acid not only lowers blood cholesterol concentration but also the tendency of the platelets was significantly decreased. On the other hand, Haumann, (١٩٩٨).showed that the saturated fatty acids with ١٦ or fewer carbon atoms raise serum cholesterol levels. In contrast, dietary, stearic acid, on ١٨ carbon atom saturated fat, does not effect. So, He thought that this may be related to stearic acid which has a relatively high melting point.

The results recorded in Tables (٥ and ٦) showed also, a linear relation between iodine value and linoleic acid content. At the same time, it was observed an inverse relationship between oleic content and linoleic acid content. On the other hand, the results indicated that the high oil varieties of sunflower are characterized by a predominance of linoleic acid over oleic acid, increases in the oil content of the sunflower seed were accompanied by increased in linoleic acid content. Such results agree with those reported by Cummins et al.,(١٩٦٧) .

Unsaponifiable matters :-

The results present in Table (٧) showed the percentage of hydrocarbons and sterols in sunflower seed oil from different varieties and hybrids.. Euroflor variety contains the lowest percentage of hydrocarbon (٢١.٤١ %) while Hybride (١٠٢) contains the highest percentage (٤٧.٠٤ %). Data present in Table (٧) showed that the total sterols of the unsaponifiable matters of sunflower varieties ranged from ٥٢.٩٦ % to ٧٨.٥٩٪. Hybrid (١٠٢) contains the lowest percentage (٥٢.٩٦ %) while Euroflor variety contains the highest percentage (٧٨.٥٩).The β – sitosterol was the major sterol fraction of total sterol followed by stigmasterol and campsterol.

Table ٧: Unsaponifiable matters (hydrocarbons and sterols) of sunflower oil extracted from different seed varieties and hybrids.

Fractions \ Variety and hybrid	Euroflor	Vidok	Hybrid –١٠٢
A- Hydrocarbons			
n-Dodecane $C_{١٢}$	-----	-----	-----
n-Tetradecane $C_{١٤}$	٠.٤٠	٠.٢٠	٥.١٣
n-Pentadecane $C_{١٥}$	-----	-----	٧.٩٧
n-Hexadecane $C_{١٦}$	٢.١٣	-----	٦.٠٢
n-Heptadecane $C_{١٧}$	-----	-----	-----
n-Octadecane $C_{١٨}$	٠.٥٠	٠.١٠	١.٨٠
n-Nonadecane $C_{١٩}$	-----	-----	-----
n-Eicosane $C_{٢٠}$	٢.٠٠	٠.٨٢	١.٧٥
n-Uncosane $C_{٢١}$	١.٤٥	١.٨٥	١.٣١
n-Docosane $C_{٢٢}$	٠.٨٤	١.٥٣	٢.٧٥
n-Tricosane $C_{٢٣}$	٤.٦٨	١.٣٦	٣.٣٠
n-Tetracosane $C_{٢٤}$	١.٢٠	٣.٧١	٤.٢٠
n-Pentacosane $C_{٢٥}$	١.٠٤	١.٢٧	٣.٤٠
n-Hexacosane $C_{٢٦}$	١.٧٥	١.٣٠	١.٩٠
n-Octacosane $C_{٢٨}$	٤.١٢	١٧.٢٤	٦.٣٦
n-Triacontane $C_{٣٠}$	١.٣٠	١.١٣	١.١٥
Total hydrocarbons	٢١.٤١	٣٠.٥١	٤٧.٠٤
B – sterols			
Campsterol	٨.٧٣	١٠.٥٥	٦.٠٣
Stigmasterol	١٣.٩٥	١٦.٣٠	١٢.٨٠
β –sitosterol	٥٥.٩١	٤٢.٦٤	٣٤.١٣
Total sterols	٧٨.٥٩	٦٩.٤٩	٥٢.٩٦

(-) Not detected

The percentage of β – sitosterol ranged from ٣٤.١٣ % to ٥٥.٩١% in different varieties and hybeids. Hybrid (١٠٢) contains the lowest percentage of β – sitosterol, while Euroflor variety contains the highest percentage. The amount of stigmasterol was ranged from ١٢.٨٠ % to ١٦.٣٠ %. Hybrid (١٠٢) contains the lowest amount while Vidok variety contains the highest amount. The

value of campesterol was ranged from ٦.٠٣ % to ١٠.٥٥ %. Hybrid (١٠٢) contains the lowest value, while Euroflor variety contains the highest value. These results are in the same line with those found by Itoh,et al.,(١٩٧٣), and E.O.S. (١٩٩٣) who mentioned that the vegetable oil sterol are known collectively as phytosterols. Two of the most common phytosterols are β – sitosterol and stigmasterol. These results also, are in accordance with those reported by Vlahakis, and Hazebroek, (٢٠٠٠).

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تأثير أصناف بذرة دوار الشمس على التركيب الكيماوى ومحتوى المعادن و خصائص الزيت وتركيب الأحماض الدهنية

منير حنا اسكندر ر – سوزان سعد لطيف – حمدي محمد عباس

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أجريت هذه الدراسة لبحث التركيب الكيميائي وخصائص الزيت لبعض أصناف دوار الشمس المصرية هجين ١٠٢ وإيروفلور وفيدوك وقد شملت الدراسة الآتى ا–التركيب الكيماوى لبذور ولب أصناف مختلفة لدوارالشمس .ب– الخصائص الطبيعية والكيماوية للزيت الناتج ج– تركيب الأحماض الدهنية والمواد الغير متصبنة لعينات الزيت بواسطة GLC وأظهرت النتائج المتحصل عليها العلاقة بين حجم البذور الزيتية ووزن الألف حبة. والنسبة بين القشرة واللب وهى تعتمد على النوع وحالة النضج والظروف المناخية للبذور. وتوجد علاقة عكسية بين محتوى البروتين والزيت .وإحتوت بذور الهجين ١٠٢ على أعلى قيمة فى محتواها من المعادن (فوسفور– بوتاسيوم– ماغنسيوم– صوديوم– زنك– نحاس– حديد– كالسيوم) وكان أقل الأصناف فى محتواه من المعادن هو الصنف إيروفلور . وأمكن الاشارة الى ان محتوى الزيت للبذور عامل هام ويتحكم فى التركيب الكلى.واشارت النتائج الى ان زيادة المحتوى الزيتى فى بذور دوار الشمس غالباً ما يكون مصحوباً بزيادة فى محتوى الزيت من حمض اللينوليك. أظهرت النتائج وجود علاقة طردية بين الرقم اليودى ومحتوى الزيت من حمض اللينوليك. ومن ناحية أخرى فقد أظهرت النتائج أيضاً وجود علاقة عكسية بين حمض اللينوليك وحمض الأوليك . وقد أظهرت النتائج أن النسبة المئوية للهيدروكربونات كانت ٢١.٤١ % ، ٣٠.٥١ % ، ٤٧.٠٤ % من المواد الغير قابلة للتصبن بالنسبة للأصناف إيروفلور ، فيدوك ، هجين ١٠٢ على التوالى . وتراوحت نسبة الأستيرولات بين ٥٢.٩٦ % ، ٧٨.٥٩ % من المواد الغير قابلة للتصبن. يعتبر البيتا ستو ستيرول هو الأستيرول الرئيسى يلية الإستجما ستيرول ثم الكامب ستيرول .