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QUALITY CHARACTERISTICS OF SOME VIRGIN OLIVE OILS IN EASTERN NORTH OF LIBYA

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ABSTRACT

The purpose of this study was to evaluate some of the physical, chemical characteristics and fatty acid composition of virgin olive oils from four different places in eastern north of Libya namely (Benghazi, El-Abiar, El-Bieda and Shahat regions). Oil samples were examined for physical properties (denisty and refractive index), chemical properties (free fatty acid, peroxide value, saponification value and iodine value) and finally the fatty acid composition. All virgin olive oil samples were compared with International Olive Oil Council (IOOC) for quality and purity criteria of olive oil. The four samples exhibited remarkable physical and chemical properties and could be useful as good quality virgin olive oils. Virgin olive oils from El-Bieda had the highest oil, denisty, refractive index, saponification value and iodine value contents and the lowest contents of free fatty acid and peroxide value when compared with other virgin olive oils. Virgin olive oil was analyzed by GC- gas chromatography for fatty acid commonly compositor fatty acid present which were: palmitic, palmitoliec, stearic, oleic, linoliec, linolenic, and arachidic. Oleic acid was found in high percentage ranged from (63.75 to 74.70 %), arachidic acid was detected in all olive oil samples, but in low percentage from the present result could be conclude of that the virgin olive oils produce in estern north Libya had a good physical and chemical quality.

INTRODUCTION

The olive tree (*Oleaeuropaea* L.) is one of the most important crops in the Mediterranean countries. The origins of the cultivation of olive tree lie rooted in legend and tradition. It probably started about 5000 – 6000 years ago within a wide strip of land by the eastern Mediterranean Sea and in the adjacent zones comparing Asia minor, part of India, Africa, and Europe (Fernandez., 1971; Muzzalupo and Perri., 2008). Others believe that the olive tree originated from Africa (Ethiopia, Egypt). Despite that olive can grow in different corners of the world, it yields abundantly in places of Mediterranean or semi Mediterranean climates and these places are considered optimal for olive farming (Angiolillo *et al.*, 1999).

Olive oil has a unique position among edible oils due to its delicate flavour. Stability and health benefits (Vekiari *et al.*, 2007). The Mediterranean people considered olive oil not only an excellent food but also a healing agents. During the past four decades a renewed interest in the nutritional and health aspects of olive oil has been generated. Olive oil is a key component of the traditional diet. which is believed to associated with a relatively long life in good health (Visioli and Galli., 1998; Tanilgan and Ozcan., 2007).

The Mediterranean diet includes the consumption of large amounts of olive oil, which contain high amounts phenolic substances (Garcia *et al.*, 2003). Virgin olive oil an excellent natural food, is obtained from olive fruit (*Oleaeuropaea* L.) by mechanical or physical procedures. Its composition varies widely, depending on fruit variety, degree of fruit ripeness, environmental conditions, growing region and techniques of processing and storage (Barranco *et al.*, 1996). The nutritional value of virgin olive oil arises from high levels of oleic acid and phenolic compounds (Caravita *et al.*, 2007; De Nino *et al.*, 2000). Nutritional value and pleasant flavour have contributed to the increase in consumption of olive oil which has fostered cultivation of olives outsides the traditional olive oil producing region of the Mediterranean and into new areas where cultivars adaptability, different climatic conditions and different agronomic practices may alter olive quality (Patumi *et al.*, 2002).

Olive oil is considered to be resistant to oxidation in comparison with other vegetable oils because of its low content of polyunsaturated fatty acids and the presence of natural antioxidants. Abundance of oleic acid, ranging from 56 to 84% of total fatty acids, is the feature that sets olive oil apart from other vegetable oils. Olive oil provides a rich source of natural antioxidants. These include carotenoids, tocopherols and phenolic compounds which may act, by different mechanisms, to confer an effective defense system against free radical attack. Although the interest in phenolic compounds is related primarily to their antioxidant activity, they also show important biological

activity in vivo and may be beneficial in combating diseases related to excessive oxygen radical formation exceeding the antioxidant defense capacity of the human body (Aparicio, et al. 1999).

The objectives of this study were evaluate the physical chemical properties of virginal oil from four different places in estern north of Libya.

MATERIALS AND METHODS

Libyan virgin olive oils cultivars were obtained from private farms during season 2014/2105 at December in the eastern north of Libya from Benghazi, El-Abiar, El-Bieda and Shahat. The samples were collected during the period when olives are usually harvested for oil production. The virgin olive oils were extracted by a mechanical pressing plant from the different olive fruit varieties. The obtained samples were immediately kept under frozen condition at -18 ±2 ºC until used.

Extraction

The oil content was determined after soxhlet extraction with petroleum ether at 70-80 ºC as solvent for 6 hrs.

Bold Analytical methods:

The analytical methods were carried out for the virgin olive oil cultivars according to the following properties:

Physical methods

Specific gravity and Refractive index were determined according the procedure of A. O. A. C (2005).

Chemical methods:

The free fatty acids F. A. A. (as oleic acid) , peroxide value PV (meq O_2/kg oil), saponification and iodine value were determined according to AOCS, (1989).

Fatty acids profile composition:

Methyl ester of fatty acids were obtained according to (Radwan, 1978) and the analysis of fatty acids was carried out using a gas chromatography .4C Shimadzu CM (PEF) equipped with stainless steel colum packed with 3% diethylene glycol succinate on chromosorb W 80/100 and flame ionization detector (FID). The oven and detector temperatures were 180 ºC isothermal and 270 ºC, respectively. N_2 was used as a carrier gas at flow rate of 20 ml/min.

RESULTS AND DISCUSSOIN

Extra virgin olive oil, as opposed to seed oils, contains a series of phenolic minor components that grant its particular aroma and taste (Taimidou *et al.,* 1992). Olive oil is the principal fat component of the Mediterranean diet, that has been associated with a lower incidence of coronary heart disease and certain cancers (Key, 1995).

The oil contents of virgin olive oils samples were shown in table (1). As shown, considerable slight differences were found in the oil contents in all samples, where, the virgin olive oil from El-Bieda had the highest content of oil. On the other hand, the virgin olive oil from Benghazi had the lowest content of oil.

The oil content were 24.50, 23.80, 18.50 and 13.00% for virgin olive oils from El-Bieda, Shahat, El-Abiar and Benghazi regions respectively. There are many physical characteristics of the edible fats and oils such as specific gravity, refractive index and color, which play an important role in assessing their qualityand palatability, as well as the consumer acceptability of the products. The physical characteristics of fats and oils are dependent on the degree of unsaturation, carbon chain length, isomeric fatty acids and molecular configuration. R The physical parameters (specific gravity and refractive index at 20 ºC) of the four virgin olive oil samples were shown in Table (1). Data revealed that values of specific gravity and refractive index at 20 ºC all varieties of the four virgin olive oils ranged from 0.913 - 0.915and 1.469 - 1.1.479 respectfully.

Table (1): Oil content and some physical properties of four virgin olive oil in Libya.

Parameter	El-Bieda	Shahat	El-Abiar	Benghazi
Oil content %	24.50	23.80	18.50	13.00
Specific gravity at 20 ºC	0.915	0.913	0.915	0.915
Refractive index at 20 ºC	1.479	1.470	1.469	1.469

These results are in agreement with those reported for five cultivars of Turkish olive oils by Tanilgan *et al.*, 2007. The specific gravity values of tested virgin olive oils are found to be within the permissible level (0.910 to 0.916) reported by EEC (2003) and International Olive Oil Council (IOOC) Trade Standard (2011).

The chemical characteristics of edible fats and oils are play an important role in assessing their quality assurance, palatability and consumer acceptability, as well as they are related with the healthy safe quality of these fats and oils by using them. Therefore, the chemical quality assurance criteria, including the acidity (free fatty acid as % oleic acid), peroxide value (meq/kg oil) thiobarbituric acid (TBA) value (mg malonaldehyde/kg oil), iodine value (gI_2/100g oil), saponification value (mg KOH/g oil) and unsaponifable matter for virgin olive oil varieties were determined. The chemical characteristics of virgin olive oil samples were shown in Table (2). As illustrated in the obtained results of Table (1), it could be indicated that slight differences were found in chemical values (free fatty acid, peroxide value, saponication value and iodine value among virgin olive oil samples. These properties especially depend on the initial quality of virgin olive oil samples. Free fatty acid as % oleic acid) was in the range of 0.20 and 0.59%. Meanwhile, Virgin olive oils should have acidity (%) $\leq$ 3.3% and the acidity contents of all samples were not higher than this limit. These results are in agreement with the data reported by Sultana and Abdrabba,

2014 for the virgin olive oil cultivars in northern east of Libya (acidity 0.48 – 0.90%) and Turkish olive oil samples (acidity 0.5 – 1.7%) by Tanilgan *et al.,* (2007). Moussa *et al.,* (1995) established free fatty acid in Koroneiki and Mastoides olive oil as 0.55 – 0.62%.

The peroxide value (meq O_2/kg oil) is a measure of primary oxidation. The results obtained also indicate that peroxide values were not higher and ranged between 4.55 – 8.00 meqO_2/kg oil. It is clear that peroxide values of all virgin olive oil samples were under the value of 20 meqO_2/kg oil, which is the maximum established by the Council for international Olive Oil. Our results are coincident with those found in study by Vekiari *et al.,* 2007.on the effects of processing methods and commercial storage conditions on the extra virgin olive oil quality indexes. Peroxide value in all samples did not exceed 20 meqO_2/kg oil of olive oil.

Saponification value of all virgin olive oil samples ranged from 189.10 to 194.00 (mg KOH/g oil). All samples were under the limits (184 – 196 mg KOH/g oil) established by C. O. I. 2003. It is worth to mention that the saponification values of all tested samples were within yhe permissible value (184 – 196) for virgin olive oil as reported by the EEC (2003) and the IOOC (2011). Iiodine value of all virgin olive oil samples ranged from (80.69 – 85.50 g of iodine/100 g oil), they were not exceeding. Limits that give very strong indication of degree of unsaturation of molecule (Dosunmu and Ochu., 1995).

Table (2): chemical properties of four virgin olive oil in Libya

Parameter	El-Bieda	Shahat	El-Abiar	Benghazi
Free fatty acid (as oleic acid)	0.20	0.25	0.56	0.59
Peroxide value (meq O2/kg oil)	4.55	6.00	6.93	8.00
Saponification value(mg KOH/g oil)	194.00	193.20	190.26	189.10
Iodine value (gI_2/100g oil)	85.50	82.63	80.69	80.69

These parameters have important roles which were influence on the quality of virgin olive oils. From the present discussion, it could be concluded that the oil samples of virgin olive oils are considered identical to the standard specification, which are found to be within the permissible levels in all terms of physical and chemical quality characteristics reported by EEC (2003) and International Olive Oil Council (IOOC) Trade standard (2011).

Fatty acid composition:

The fatty acid composition of the four virgin olive oils samples were determined by gas chromatography .The results are shown in Table (3). Olive oils contain fatty acid present in virgin olive oil samples, such as palmitic, palmitoleic, stearic, oleic, linoliec, linolenic and arachidonic acids had specific carbon number as

C16:0, C16:1, C18:0, C18:1, C18:2, C18:3 and C20:O,respectively.

There were differences among the samples were observed. Oleic acid was present in the highest concentration; the values were ranged between (63.75% and 74.70%) it was followed by palmitic acid (11.19% – 16.13%), linoleic acid (7.01% - 14.93%), stearic acid (2.48% - 3.48%), palmitoleic acid (0.68% - 2.06%), linolenic acid (0.42% - 0.77%) and arachidic acid (0.38% - 0.55%).

Sample from SM3 contained the highest concentration of oleic acid (74.70%) but sample from OIL 4 contained the lowest percentage of the same fatty acid (63.75%). Palmitic fatty acid was not exceeding 17%.

Table (3): Fatty acid profile (expressed as oleic acid %) of four olive virgin oils in Libya

Parameter		Shahat	Benghazi	El-Baida	Alabair
C16:0	Palmitic	15.49	16.13	11.19	12.25
C16:1	Palmitoleic	2.06	1.56	0.85	0.68
C18:0	Stearic	3.48	2.48	3.34	3.18
C18:1	Oleic	70.90	63.75	74.64	74.70
C18:2	Linoleic	7.01	14.93	8.96	8.30
C18:3	Linolenic	0.51	0.77	0.59	0.42
C20:0	Arachidic	0.55	0.38	0.43	0.47
SUM SFA		19.52	18.99	14.96	15.9
SUM MUSFA		72.96	65.31	75.49	75.38
SUM PUSFA		7.52	15.7	9.55	8.72

SFA = Saturated Fatty Acid
MUSFA = MonoUnSaturatedFatty Acid; **PUSFA** = Poly UnSaturated Fatty Acid.

These results are in agreement with those obtained by Sultana and Abdrabba., (2014) for some olive oil cultivars in Libya, and also concordance with results obtained by Boukachabine *et al.,* 2011 and Abdalla *et al.,* 2014 for some olive oils samples from Morocco.The factors that influence the oils composition of fatty acids and especially oleic acid were altitude, climate, variety and olive maturity are mentioned (Ranelli *et al.*, 1997).

CONCLUSION:

El-Buda olive had the huyhat level of oil virgin of the oil produced in estrus north Libya had a high physical and chemical quality.

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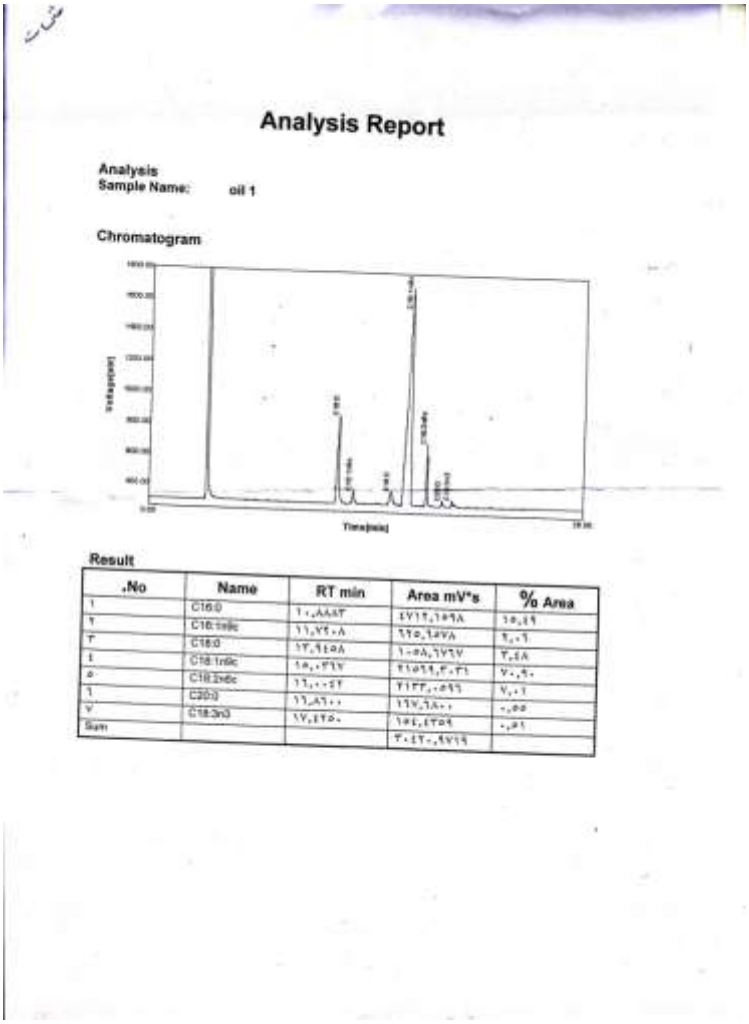


Analysis Report

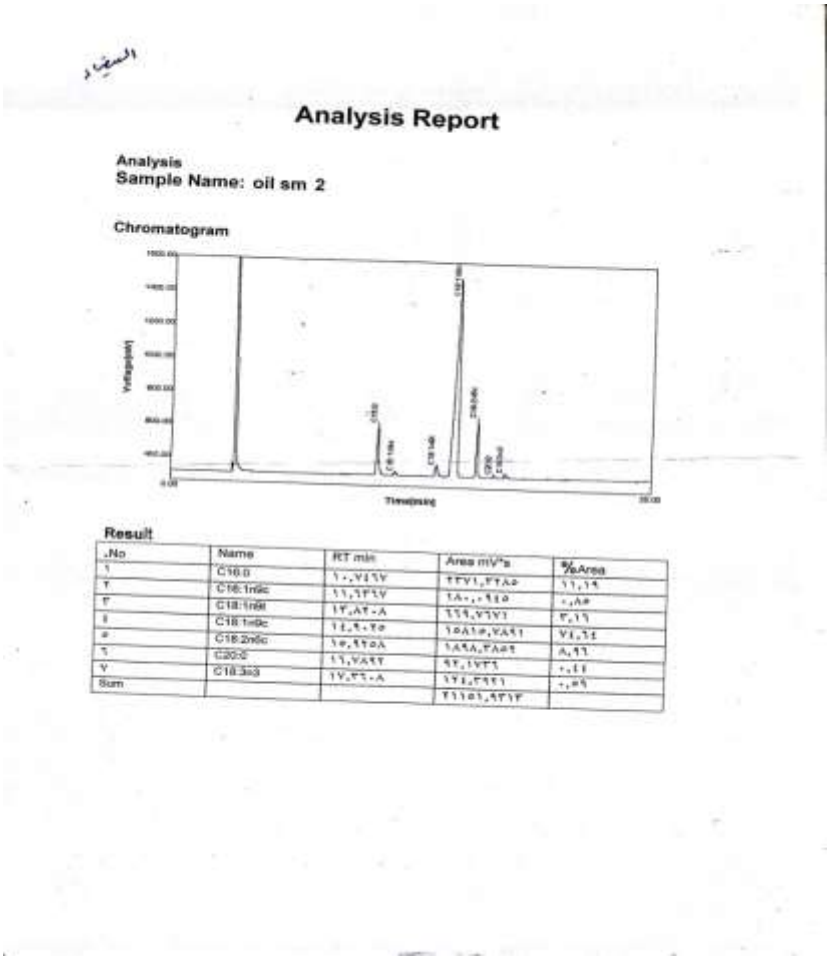
Analysis
Sample Name: oil 1

Chromatogram

Result

.No	Name	RT min	Area mV*s	% Area
1	C16:0	١٠,٨٨٤٣	٤٧١٢,١٠٩٨	١٥,٤٩
٢	C16:1n9c	١١,٧٩٠٨	٩٩٥,١٥٧٨	٣,٠٦
٣	C18:0	١٢,٩٤٥٨	١٠٥٨,٦٧٦٧	٣,٤٨
٤	C18:1n9c	١٥,٠٩١٧	٩١٥٦٤,٣٠٣١	٧٠,٩٠
٥	C18:2n6c	١٦,٠٠٥٢	٢١٣٣,٠٥٩٦	٧,٠١
٦	C20:0	١٦,٨٦٠٠	١٦٧,٦٨٠٠	٠,٥٥
٧	C18:3n3	١٧,٤٢٥٠	١٣٤,٤٣٥٩	٠,٤١
Sum			٣٠٤٢٠,٩٧١٩	

Fig (1):- Fatty acids composition of olive oil cultivated from Shahat- Libya



Analysis Report

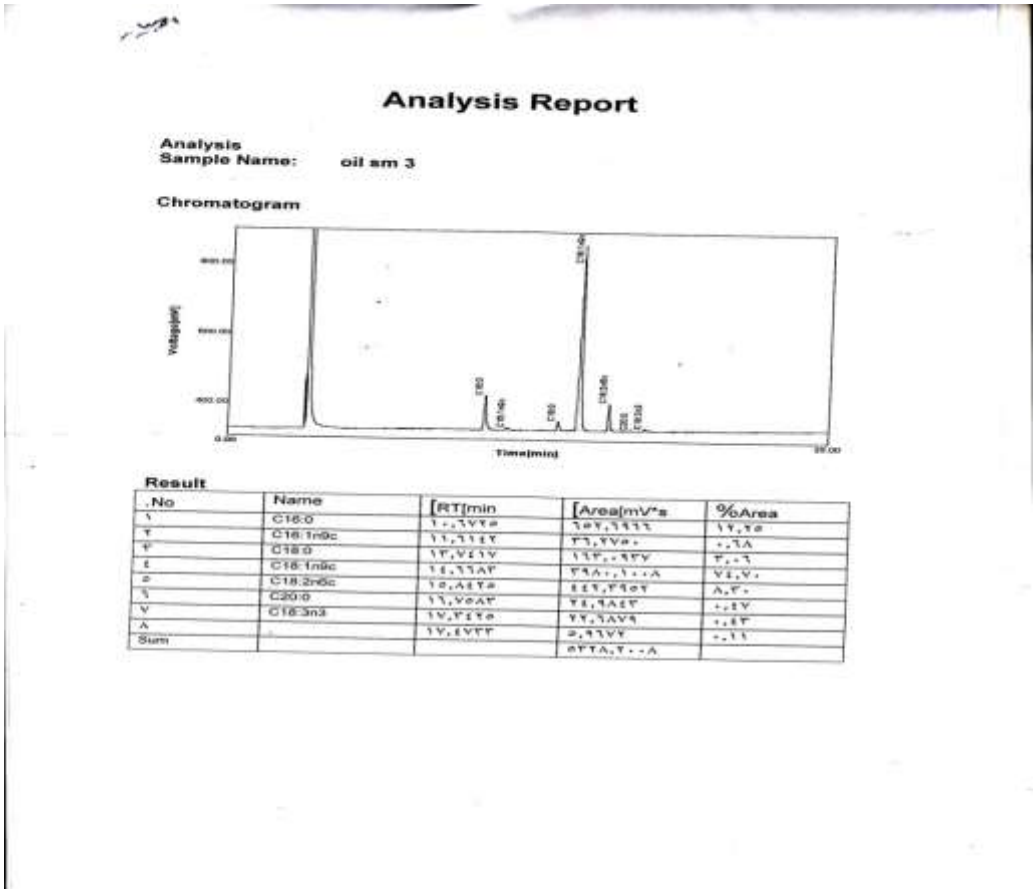
Analysis
Sample Name: oil sm 2

Chromatogram

Result

.No	Name	RT min	Area mV*s	%Area
١	C16:0	١٠,٧١٦	٢٢٧١,٢٢٨٥	١١,١٩
٢	C16:1n9c	١١,٢٢٧	١٨٠,٠٩٥٥	٠,٨٥
٣	C18:1n9t	١٢,٨٢٠٨	٦٦٩,٧٦٧١	٣,١٩
٤	C18:1n9c	١٤,٩٠٢٥	١٥٨١٥,٧٨٩١	٧٤,٦٤
٥	C18:2n6c	١٥,٩٢٥٨	١٨٩٨,٣٨٥٩	٨,٩٦
٦	C20:0	١٦,٧٨٩٢	٩٢,١٧٢١	٠,٤٤
٧	C18:3n3	١٧,٣٦٠٨	٦٦,٢٩٢١	٠,٣٩
Sum			٢١١٥١,٩٢١٢	

Fig (2):- Fatty acids composition of olive oil cultivated from El-Baida- Libya



Analysis Report

Analysis
Sample Name: oil sm 3

Chromatogram

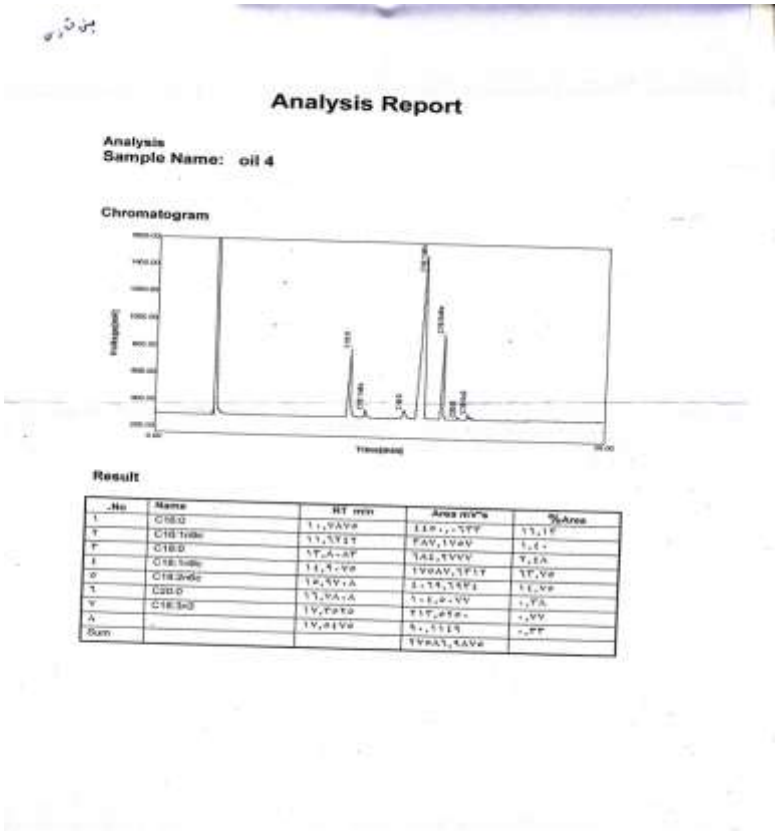
Voltage[uV]

Time[min]

Result

.No	Name	[RT[min	[Area[mV*s	%Area
١	C16:0	١٠,٦٧٢٥	٦٥٢,٦٩٦٦	١٢,٢٥
٢	C16:1n9c	١١,٦١٤٢	٢٦,٢٧٥٠	٠,٦٨
٣	C18:0	١٣,٧٤١٧	١١٣,٠٩٢٧	٢,٠٦
٤	C18:1n9c	١٤,١٦٨٣	٣٩٨٠,١٠٠٨	٧٤,٧٠
٥	C18:2n6c	١٥,٨٤٢٥	٤٤٩,٣٩٥٢	٨,٣٠
٦	C20:0	١٦,٧٥٨٣	٢٤,٩٨٤٣	٠,٤٧
٧	C18:3n3	١٧,٣١٢٥	٢٢,٦٨٧٩	٠,٤٣
٨		١٧,٤٧٢٢	٥,٩٦٧٢	٠,١١
Sum			٥٣٦٨,٢٠٠٨	

Fig (3):- Fatty acids composition of olive oil cultivated from AL-Abair- Libya



Analysis Report

Analysis
Sample Name: oil 4

Chromatogram

Result

No.	Name	RT min	Area mV*s	%Area
1	C16:0	١٠,٩٨٧٥	٤٤٥٠,٠٦٢٢	١٦,١٢
٢	C16:1n9c	١١,٦٧٤٢	٢٨٧,١٧٥٧	١,٤٠
٣	C18:0	١٣,٨٠٨٣	١٨٤,٩٧٧٧	٢,٤٨
٤	C18:1n9c	١٤,٩٠٧٥	١٧٥٨٧,١٣٤٢	٦٣,٧٥
٥	C18:2n6c	١٣,٩٧٠٨	٤٠٦٩,٦٩٣٤	١٤,٧٥
٦	C20:0	١٦,٣٨٠٨	١٠٤,٥٠٧٧	٠,٣٨
٧	C18:3n3	١٧,٢٣٦٥	٢١٢,٥٦٥٠	٠,٧٧
٨		١٧,٥١٧٥	٩٠,١١٤٩	٠,٣٣
Sum			٢٧٨٨١,٩٨٧٥	

Fig (4):- Fatty acids composition of olive oil cultivated from Benghazi- Libya

الملخص العربي

خصائص الجودة لبعض انواع زيت الزيتون البكر من شمال شرق ليبيا

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يهدف البحث الى دراسة بعض الخواص الفيزيائية والكيميائية وتركيب الاحماض الدهنية لعينات من زيت الزيتون البكر جمعت من اربع مناطق مختلفة من شمال شرق ليبيا هى (بنغازى – الابيار – البيضاء – شحات) . شمل تقدير الخواص الفيزيائية (الكثافة – معامل الانكسار) وبعض الخواص الكيميائية مثل (الاحماض الدهنية الحرة – رقم البيروكسيد –رقم التصبن – الرقم اليودى – تركيب الاحماض الدهنية) كل عينات زيت زيتون البكر تم مقارنتها بمعايير الدجودة والنقاوة المعتمدة من المجلس الالعالمى لزيت الزيتون " IOOC ". حيث اظهرت العينات الاربعة خواص فيزيائية وكيميائية جديرة بالملاحظة ويمكن استخدامها كزيوت قابلة للاكل ، وعينات زيت الزيتون البكر من المتحصل عليها من مدينة البيضاء كانت الاعلى من محتوى الزيت والكثافة ومعامل الانكسار ورقم التصبن والرقم اليودى والاقل فى محتوى الاحماض الدهنية الحرة ورقم البيروكسيد عند مقارنتها مع بقية عينات زيت الزيتون البكر الاخرى. تم تحليل عينات زيت الزيتون الكر ياستخدام " GLC " والتعرف على تركيب الاحماض الدهنية الشائعة المتواجدة مثل " البالمتك – البالموليك – الاستياريك – الاوليك – اللينوليك – اللينولينيك – الاراكودينك–" كان حمض الاوليك الاعلى نسبة بحيث تراوحت بين " 63.75 – 74.70 " % وحمض الاراكودينيك تم الكشف عن تواجده فى عينات زيت الزيتون البكر بكميات منخفضة .

الكلمات الدالة – زيت الزيتون – شرف ليبيا– الخواص الفيزائية والكيمائية