Oils and fats: detection methods for evaluation, chemical characterization, and diagnosis of their antioxidant effects

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Abstract:

introduction: Given the importance of oils and fats and their close association with human health, it is essential to study and describe their basic components to understand their biological and chemical properties. **Methods:** This study focused on the characterization of "Sunflower oil (Al-Dar)", virgin olive oil "Kul Al-Afiyah Oil" **,** and **"**Animal Fat – Abu Ghraib". Using ultraviolet-visible (UV-Vis), Fourier-transform infrared (FTIR), and gas chromatography-mass spectrometry (GC-MS), and to study their antioxidant properties. Results:
Wavelengths in the range of 200 to 400 nm were investigated, and the absorbance of the selected samples was found at wavelengths of 278, 290, and 265 nm, respectively. Spectroscopic analysis was used to identify functional groups on the surfaces of sunflower and olive oils. Fourier-transform infrared. Spectroscopy with component analysis was used to identify different functional groups. By examining the absorption peaks between 4000 and 500 cm¹, animal fats performed better when measuring their effectiveness in preventing oxidation**.** "Animal Fat – Abu Ghraib" recorded the highest free radical scavenging capacity, reaching 54.5695%, while virgin olive oil "Kul Al-Afiyah Oil" recorded 22.9139 %. And "Sunflower oil (Al-Dar)"recorded 4.23841% .The results indicated that the selected samples contained biologically active chemical compounds; however, animal fat exhibited significantly higher antioxidant properties.

Keywords: "Sunflower oil (Al-Dar)", virgin olive oil "Kul Al-Afiyah Oil" **,** "Animal Fat – Abu Ghraib", GC- MS, FTIR

Note: The research is based on an M.A thesis or a PhD dissertation (NO).

Introduction:

Contemporary human diets, technology, and health constitute a major first step toward adopting healthy eating habits. One of the problems facing humans is the accumulation of harmful fats, which affect living cells and cause diseases such as stroke, atherosclerosis, and heart attacks. Therefore, it is important to know the sources of fats. Vegetable oils and animal fats are considered effective because they contain compounds as Omega-3, Oleic Acid and Alpha-Linolenic

Acid etc" that maintain the functions of vital organs in the body [1]. Dietary patterns affect human health in significant functional ways, and variations in the structural and physiological components of dietary fats and oils influence these patterns. Obesity, diabetes, vascular disease, and inflammation of the intestines are just some of the health issues linked to a diet high in fatty and oily foods Microbes in the gut are an integral part of the immunological barrier because of the crucial role they play in detecting abnormal dietary patterns that disrupt regular intestinal processes. Some oils, including omega-3 and cereal oils, are physiologically active and help keep microbes in check because they contain fatty acids or fat-soluble components. Choosing oils or fats and learning about their components is crucial for understanding how they affect gut bacteria and the inflammatory response in the intestines [2]. The exact composition of an oil, including its fatty acid content, depends on the type of oil or fat, storage conditions, and cultivation (plants). The oleic acid concentration in plant seed oils can vary greatly. The average fatty acid composition of the predominant fatty acids depends on the seed type [3]. Fatty acids are classified as saturated (especially palmitic, stearic, and linoleic acids) and unsaturated (especially oleic, linoleic, and linolenic acids). The composition of oils and fats is important because it affects the reaction conditions [4] Oils and fats contain active chemical compounds such as glycerides, which are esters composed of long-chain fatty acids and glycerol. Chemical analysis, such as gas chromatography (GC-MS) or Transform Infrared Spectroscopy can characterize free fatty acids, water, and others. A high concentration of fatty acids attached to triglyceride affects physicochemical properties, such as viscosity, iodine value, and oxidative stability [5]. The main sources of energy in food are fats and oils. Most fats are triglycerides, composed primarily of glycerol and fatty acids. Diet plays an important role in nutritional value. There are different types of fats, such as margarine and animal fat, and they distinguished by their taste and smell. Excessive consumption or use of saturated fats is a major factor in weight gain and obesity, which in turn increases the risk of diabetes and insulin-related disorders [6]. Fatty acids are the main component of saturated fats, which are a hydrocarbon chain composed mainly of carbon and hydrogen that are solid at room temperature. Many recent studies have indicated the association of saturated fats with cholesterol, which increases the level of low-density lipoprotein (LDL) and thus exposes one to heart disease or atherosclerosis [7]. Oils and fats are naturally found in plant and animal tissues. They are very important for nutrition, as they provide energy for the body and aid in the absorption of fat-soluble vitamins, such as A, D, E, and K. These vitamins also act as antioxidants, thanks to their chemical composition, which interacts with

vital body systems. Fats are solid or liquid, depending on age and body composition, they are often composed of triacylglycerol and fatty acids [8]. The chemical composition of fats and oils can be analyzed through various techniques, including chromatography and Fourier Transform Infrared Spectroscopy (FTIR). FTIR utilizes ultraviolet or infrared light to examine the molecular behavior of oils and fats, offering insights into their interaction with biological tissues [9].

Cancer and tumor-causing free radicals represent a major global health challenge, and there is growing interest in exploring natural compounds as potential therapies to reduce and mitigate free radicals and oxidative stress in cells [10]. Fatty acids and plant oils are a new source of bioactive compounds with therapeutic potential, are attracting interest due to their traditional medicinal uses, and documented anticancer properties [11]. Oncologists continue to search for new and less expensive treatments. Prostate and breast cancer, two of the most common malignancies in men and women, have seen significant advances in both diagnostics and alternative therapies, ranging from conventional surgery and radiotherapy to advanced immunotherapies and hormonal therapy. However, there is still a need to improve treatments at various stages of cancer, often by combining radiotherapy with hormonal or drug therapies, along with a healthy diet to improve outcomes [12]. .

Natural oils and fats represent promising sources of compounds with antioxidant properties, which play a vital role in protecting the body from free radical damage and thus preventing many chronic diseases, such as heart disease, cancer, and premature aging. These compounds are even more important when extracted from natural sources, as they are considered safer than synthetic antioxidants [13]. Modern analytical methods, particularly gas chromatography-mass spectrometry (GC-MS), have helped accurately identify the components of oils and fats, allowing us to find important compounds that offer antioxidant benefits, such as fatty acids, tocopherols, phenols, and sterols. These analyses have also contributed to assessing the quality of oils, detecting adulteration, and improving extraction and refining processes. Therefore, enhancing the use of natural oils rich in antioxidants and developing methods for their extraction and analysis represents an important scientific and economic direction in the fields of food, medicine, and cosmetics. This calls for further research to explore new oils and improve our understanding of the relationships between chemical composition and biological activity [14].

The present study aims to evaluate and compare the chemical properties of organic compounds present in oils and sunflower oil " AL Daar ", virgin olive oil **"**Kul Al-Afiyah Oil , and "Animal Fat – Abu Ghraib"   available in the Iraqi

markets, in addition to studying their UV absorption spectra and evaluating their antioxidant capacity in a laboratory environment.

2. Materials and Methods:

2.1. Samples: This study analyzed three types of sunflower oil (Al-Dar), virgin olive oil (Kol Al-Afia), and Abu Ghraib animal fat. Samples were obtained from Iraqi markets in November 2024. These components were stored in a dry, dark place away from sunlight and at room temperature between 15 and 20°C, while the animal fat was stored at 4°C to maintain stability before analysis. The expiration dates for Al-Dar sunflower oil, of Iraqi origin, were (2024-2026), Kol Al-Afia virgin olive oil, of Iraqi origin, (2023-2026), and Abu Ghraib animal fat, of Iraqi origin, were (2025-2026).

2..2 UV-Vis spectrometer :The test was performed on three samples using a UV-Vis spectrometer (model: Agilent Cary 100) in the wavelength range of 190-900 nm. The system has a high-throughput single-dispersion optical configuration with a fully reflective design and a high-speed scanner [15].

2.3. FT-IR spectroscopy: In this study, sunflower and olive oils and animal fats were studied, and Fourier transform infrared (FTIR) spectroscopy was used to identify and characterize the functional groups of the sample, used a Perkin-Elmer Spectrum 100 series instrument from the American company Perkin-Elmer. Using FTIR, chemical functional groups reveal the chemical properties of organic, inorganic, and polymeric materials. The FTIR spectroscopy range is 4000–600 cm^{-1} [16].

2.3. GCMS technique: The GCMS detection technique to identify the active chemical components in the three selected oils. An Agilent 7890A GC system equipped with a 5975C VL MSD (Agilent Technologies, CA, U S A) was used to analyze the samples. A DB5MS capillary column (30 m × 0.25 mm, 0.25 μm film thickness; J&W Scientific, CA, USA) was used at an initial oven temperature of 50 °C for 1 min. Components were identified by looking at how long they stayed on the capillary column and using GC-MS data from the NIST library [17].

**2.4 DPPH free radical scavenging activity of selected samples was determine:**

Samples at concentrations of 0.0625, 0.1250, 0.2500, 0.5000, and 1.0000 μg/ml of oil and fat were collected using a reference standard. The reaction mixture was incubated in the dark at room temperature, and the absorbance at 517 nm was recorded after a specified period of time. Ascorbic acid concentration was used as a control sample, while vitamin C and H_2O were used as reference standards. [18] demonstrated this process with some modifications. The equation used to measure DPPH activity is:

Scavenging activity (%) = (1 - oil absorbance / control absorbance) × 100%

3. Results and Discussion :

3.1. Chemical evaluation and characterization of oils and fats:

3.1.1. Ultraviolet absorption spectroscopy : The visible light absorption spectroscopy and ultraviolet absorption spectroscopy of the samples ("Sunflower Oil (Al Dar)", "Kol Al Afiah" virgin olive oil, and "Abu Ghraib animal fat") were measured as they consist of hydrocarbon molecules adapted to absorb light at specific wavelengths within the electromagnetic spectrum [19]. The transmittance of the samples at wavelengths (samples A, B, and C) ranged from 200 to 400 nm, with the wavelengths being (278, 290, and 265) nm, respectively, as shown in Figure 1. The results are close to those obtained by Musa et al., using olive oil [20].while Hsieh et al., [21] used UV-vis spectroscopy on beef tallow, chicken oil, pork lard, and sheep oil at temperatures between 120°C and 180°C and discovered that the absorbance occurred between 400 nm and 500 nm.
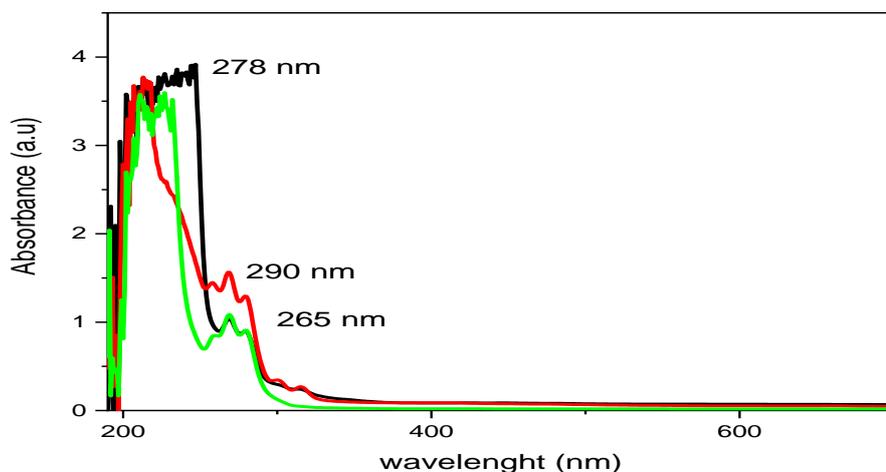

Figure 1: UV-vis absorption spectra for A: "Sunflower oil (Al-Dar)"(green) B: virgin olive oil "Kul Al-Afiyah Oil" (red) "Animal Fat – Abu Ghraib" (black)

3.1.2. Fourier transform infrared (FTIR):

Fourier transform infrared (FTIR) spectroscopy was used to identify the functional groups on the surface of sunflower) Al Daar) and olive oils, . Figures 2a and 2b show that the spectra of sunflower and olive oils were similar in most of the C-H functional groups, spanning from 3000 to 3200 cm¹. The C-H stretching vibration was observed at (2924.09–2852.72) cm^{-1}, and the C=O stretching functional group at 1745.58 cm^{-1}. The absorption bands at 1600 cm^{-1}– 1400 cm^{-1} (centered at 1647.21 cm^{-1}) represent the vibration of the C=O and C=C functional groups. The band (1163.08–1097.50) cm^{-1} appeared, indicating

the presence of a C−O−C stretching group. The band at C–H bending in alkenes. , while 721.3 cm⁻¹ vibration of long-chain methylene (–CH₂–) groups in alkanes. , and the band at 472.56 cm⁻¹ indicated vibration of –CH₂– chains (saturated hydrocarbons. The absorption peak at 3400.50 cm⁻¹ indicated the OH functional group the results were similar to those obtained by Nizar et al. [22].
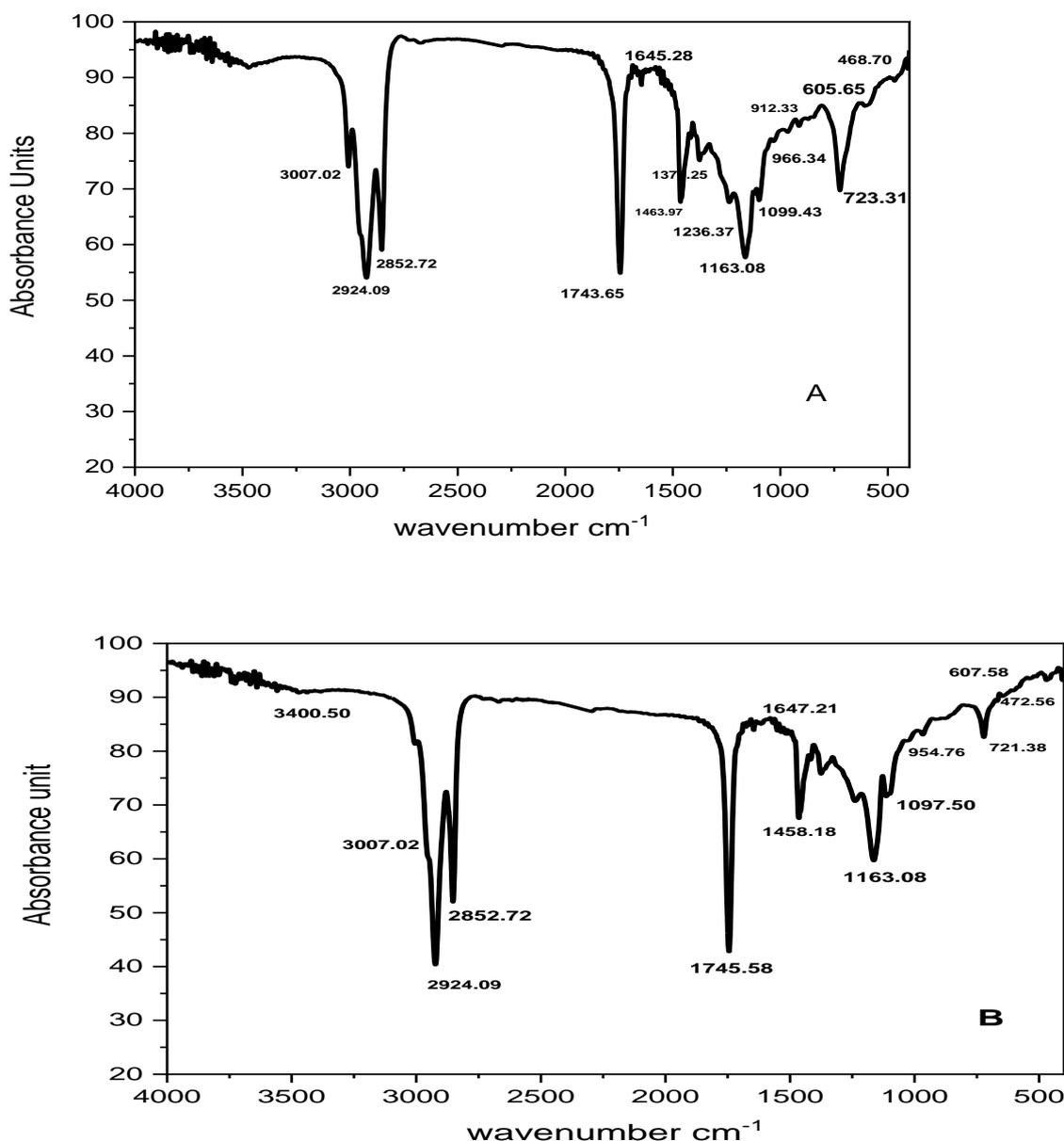
Figure 2 A and 2B: Fourier transform infrared (FTIR).A: of ''sunflower oil (Al-Dar)'', B: virgin olive oil "Kul Al-Afiyah Oil"

Fourier transform infrared (FTIR) spectra were used to identify the functional groups of animal fats in the range of 4000–600 cm. In Figure 2 C, the C–H functional groups can be seen at 3005.10 cm⁻¹, and the CH_2 and CH_2 asymmetric C–H stretching vibration band can be seen at 2924.09 cm⁻¹ to 2852.72 cm⁻¹. The peak at ~1463.97cm⁻¹ corresponds to the symmetric scissoring vibration of the –CH_2– (methylene) groups in long-chain hydrocarbons. The band at 1238.30 cm⁻¹ show the presence of a C–H bending group, and the C–C bond with a hydrocarbon chain causes the band at 1163.08 cm. The vibration band (1099.43 cm⁻¹ - 1031.92 cm⁻¹) is attribute to the C–O stretching.

While the band is located at 966.34 cm¹, the vibrations indicate the presence of double bonds (C=C), indicating the presence of unsaturated fatty acids. The presence of vibrations of –CH_2– groups in saturated hydrocarbons at 721.38 cm⁻¹. At 603.72 cm¹, a characteristic bending vibrational pattern was found for the methylene groups (–CH_2–) in the lipid molecules. The low frequency band, at 470.63 cm⁻¹, denotes complex twisting motions, or vibrations associated with large structures, such as dense hydrocarbon groups (like the long chains in lipids). . The results were similar to those obtained by Fajriati et al [23]. While in this study, Hsieh et al., [21]   used tallow, chicken, lard, and sheep oils for different heating periods at 120°C. Upon heating, animal oils containing triglycerides undergo chemical changes, including the conversion of double bonds from the cis to the Trans form and oxidation, which produces byproducts such as aldehydes, carboxylic acids, ketones, and hydrocarbons. Fourier transform infrared (FTIR) spectra of the heated animal oils show changes in peak intensity and position, reflecting changes in chemical composition. These transformations represent a potential health risk, as the resulting Trans fatty acids are suspected of contributing to atherosclerosis and heart disease.
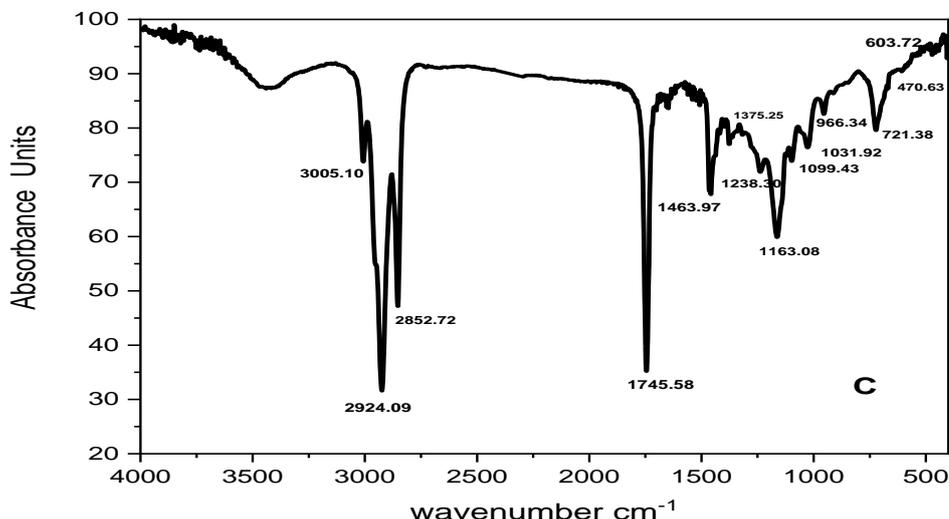
Figure 2 C: Fourier transform infrared (FTIR) of "Animal Fat – Abu Ghraib".

3.1.3. Gas Chromatography-Mass Spectrometry (GC-MS):.

The different sampling standards are analyzing separately, and the active compounds are determined using gas -spectrum measurements (GC -MS) while determining their retention times and fractures in the mass. Initially, the detector was assigned to a scanning mode, which covers a range of the area under the peak curve that represents the chemical compound on a scale as shown in Table 1. The mass mode records included the most important signals, detailing the breakdown of these compounds.. The database included these saturated and unsaturated fatty acids, individual chains, alcohol, and fragments that can be formed from it [24], [25]. In the figure, 3A explains a streamlined GC-MS technology for analyzing chemical compounds over time. . Hexadecanoic acid (RT = 57.451), oleic acid (RT = 57.48), 9-octadecenoic acid (E) - (RT = 63.041), 9-octadecenoic acid (Z)- (RT = 63.098), cis-vaccenic acid (RT = 63.692), cyclopropanooctanal, 2-octyl- (RT = 67.03), and 8-octadecenoic acid, methyl ester, (E)- (RT = 67.15) .

While the graph of olive oil shows the chemical compounds shown in Figure 3B linoleic acid (RT = 49.261), n-hexadecanoic acid (RT = 57.474), 9-octadecenoic acid (E)- (RT = 63.075), oleic acid (RT = 63.126), 9-octadecenoic acid (Z)- (RT = 63.692), and cis-13-octadecenoic acid (RT = 67.024),
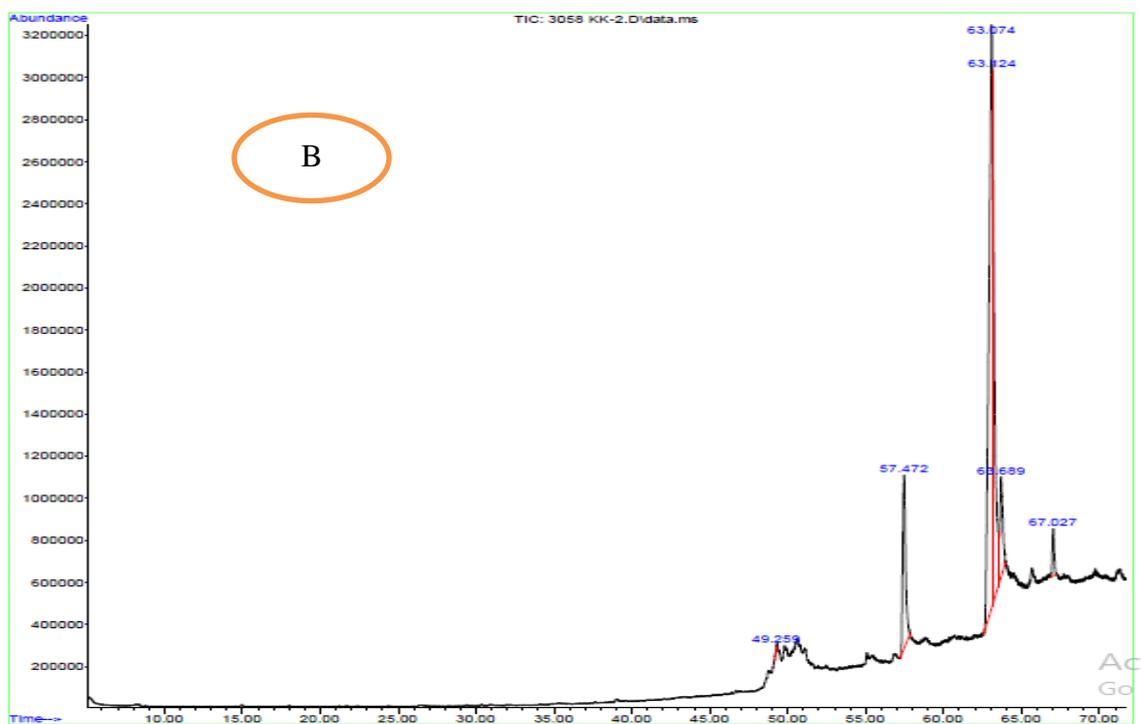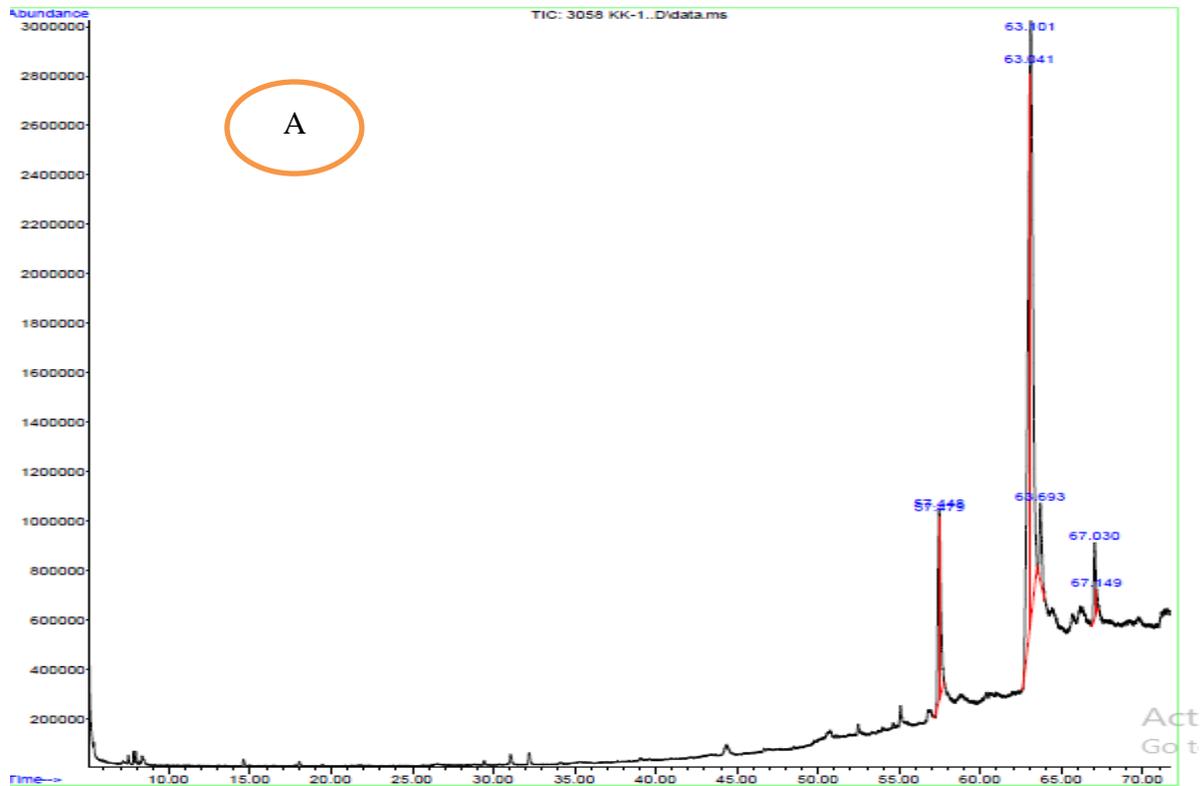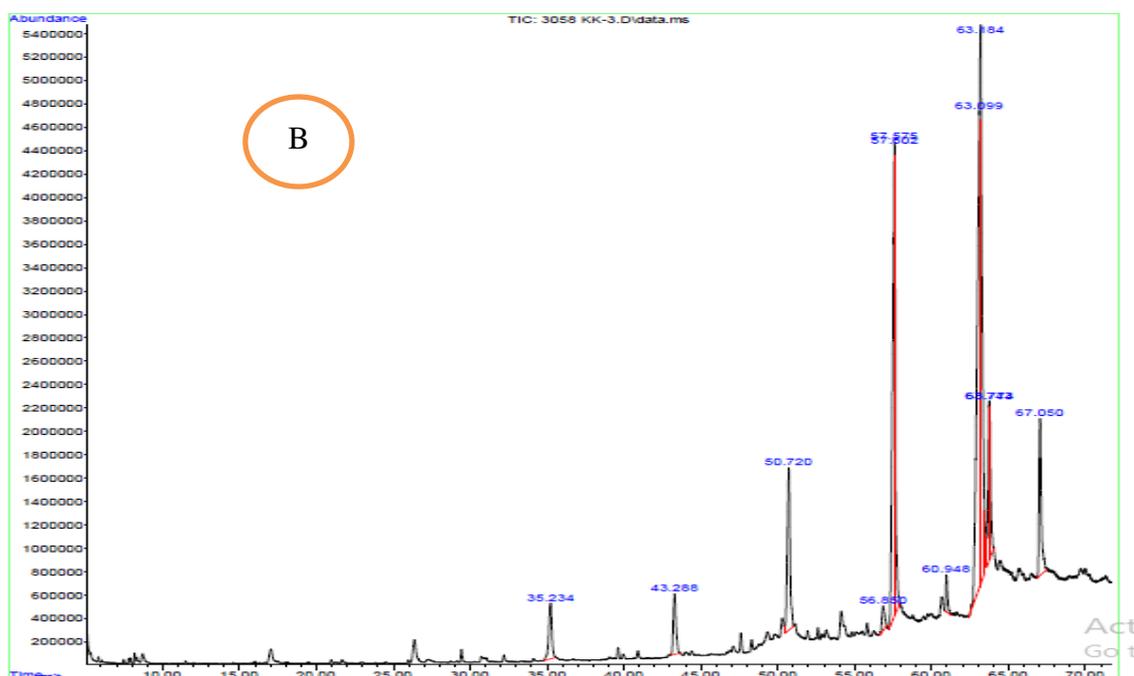
Figure 3: Total ionization chromatogram (TIC) of gas chromatography. a: sunflower oil (Al daar) b: virgin olive oil "Kul Al-Afiyah Oil" C: ''Animal Fat – Abu Ghraib''.

shows in figure 3c , n-Decanoic acid (RT = 35.236) , Decanoic acid(RT= 43.289), Hexadecanoic acid(RT =57.577) , 9-Octadecenoic acid (Z)-(Rt =57.6) , Cyclohexane, 1-(1,5-dimethylhexyl)-4-(4-methylpentyl)- (RT =60.949), 6-Octadecenoic acid(RT =63.098) ,9-Octadecenoic acid (E)- (RT=63.184) , 1-Heptadecanecarboxylic acid (RT =63.744) , Glycidyl palmitate (RT =63.772) , 6-bromo-3-(2'-hydroxyethyl)quinolin-2(1H)-one(RT =67.047). Because the column used was partial, the mass spectra and fragmentation data for all these standards reflected various measurable sample parameters in terms of residence time, molecular ions, and fragments resulting from fatty acid and fatty alcohol molecules [26]، as shown in Table1.

Table1: important chemical compounds in GC-MS of a: sunflower oil (Al daar), b: virgin olive oil "Kul Al-Afiyah Oil", C: ''Animal Fat – Abu Ghraib''.

No.	kind	compounds	TR	Area %
1		n-Hexadecanoic acid	57.451	7.47
2		Oleic Acid	57.48	7.01
3		9-Octadecenoic acid, (E)-	63.041	33.44
4	A	9-Octadecenoic acid (Z)-	63.098	42.86
5		cis-Vaccenic acid	63.692	4.79

6		Cyclopropaneoctanal, 2-octyl-	67.03	3.82
7		8-Octadecenoic acid, methyl ester, (E)-	67.15	0.62
1		Linoelaidic acid	49.261	0.07
2		n-Hexadecanoic acid	57.474	13.31
3		9-Octadecenoic acid, (E)-	63.075	47.62
4	B	Oleic Acid	63.126	29.7
5		9-Octadecenoic acid (Z)-	63.692	7.06
6		cis-13-Octadecenoic acid	67.024	2.25
1		n-Decanoic acid	35.236	3.16
2		Decanoic acid	43.289	2.94
3		Tetradecanoic acid	50.718	8.06
4	C	Octadec-9-enoic acid	56.851	1.18
5		Hexadecanoic acid	57.577	16.4
6		9-Octadecenoic acid (Z)-	57.6	7.73
7		Cyclohexane, 1-(1,5-dimethylhexyl)-4-(4-methylpentyl)-	60.949	1.25
8		6-Octadecenoic acid	63.098	20.3
9		9-Octadecenoic acid (E)-	63.184	25.34
10		1-Heptadecanecarboxylic acid	63.744	3.61
11		Glycidyl palmitate	63.772	3.49
12		6-bromo-3-(2'-hydroxyethyl)quinolin-2(1H)-one	67.047	6.53

3 .2: Evaluation as an antioxidant to combat free radicals in oils and fats:
In vitro antioxidant tests are designed to simulate the redox reactions occurring in living biological systems to estimate the antioxidant capacity of various chemical and biological samples [27]. In this study, the DPPH test was used to evaluate the antioxidant potential of animal oils and fats by measuring their ability to scavenge stable free radicals. Ascorbic acid, a well-known and effective antioxidant, was used as a positive control to provide a reliable standard. Table 3 displays the antioxidant activity values of the samples, while Table 2 facilitates comparison between the samples and the control. The inclusion of a positive control is a crucial step in in vitro testing to accurately assess the relative effectiveness of the tested samples. This comparison allows for an accurate estimation of the samples' free radical resistance.
The antioxidant capacity (the volume required to capture a fixed amount of free DPPH) was significantly higher in the detoxification activity of the tested animal fats against free radicals than their activity against DPPH. Compared to olive oil and sunflower oil, the DPPH reactivity of the tested samples showed significant

differences in the level of DPPH reactivity depending on the type of antioxidant. Series C showed high reactivity to DPPH, while samples A and B showed lower reactivity to DPPH, as shown in Table 4. The free radical scavenging activity was found to be concentration-dependent; the higher the sample concentration, the higher the free radical scavenging capacity. Sample C, as shown in Table 3, showed the highest antioxidant activity compared to samples A and B. The ratios of antioxidant concentrations were found to be 54.5695 %, 22.9139**%** , and 4.23841%, respectively, as shown in Table 3. Similar results were reported by Kazlauskin [28]. While the study aimed to highlight the important role played by temperature and storage conditions in maintaining the effectiveness of animal oils and fats, researcher Gungoren [29] selected three different types of extra virgin olive oil and stored them under different conditions, including time, temperature, and light exposure, for six months. Chemical changes and antioxidant levels were evaluated at the beginning of the storage period, after three months, and again after six months. The results showed a significant decrease in oxidative activity, along with significant chemical changes in active compounds, indicating that time and storage conditions have a clear impact on the quality and health properties of the oils.

Table 2: DPPH of Ascorbic Acid (control)

Ascorbic Acid concentration (µg/ml)						
Con.	**0**	**7.8**	**15.6**	**31.2**	**62.5**	**125**	**250**
s1	366	333	312	303	261	273	181
s2	389	347	324	326	281	264	152
mean	377.5	340	318	314.5	271	268.5	166.5
SD	16.26346	9.899495	8.485281	16.26346	14.14214	6.363961	20.5061
SEM	11.61675	7.071068	6.060915	11.61675	10.10153	4.545686	14.64721
	0	0.099338	0.157616	0.166887	0.282119	0.288742	0.55894
%DPPH activity	0	9.933775	15.76159	16.68874	28.21192	28.87417	55.89404

Table 3: DPPH antioxidant activity of samples: A : sunflower oil (Al daar)   B : virgin olive oil "Kul Al-Afiyah Oil   )   C: Animal Fat – Abu Ghraib".

		vit C	H2o (ctrl)	0.0625 µg/ml	0.125 µg/ml	0.25 µg/ml	0.5 µg/ml	1 µg/ml
S1		102	361	285	296	295	329	358
S2		113	380	283	291	292	328	365
mean		107.5	370.5	284	293.5	293.5	328.5	361.5
SD	A	7.77817	13.4350	1.41421	3.535533	2.12132	0.70710	4.94974
SEM		5.55583	9.59644	1.01015	2.525381	1.51522	0.50507	3.53553
		0.71523	0.01854	0.24768	0.222516	0.22251	0.12980	0.04238
% of antioxidant activity			1.85430	24.7682	22.25165	22.2516	12.9801	4.23841
S1		102	361	278	251	274	163	293
S2		113	380	275	246	263	161	289
mean	B	107.5	370.5	276.5	248.5	268.5	162	291
SD		7.77817	13.4353	2.12132	3.535533	7.77817	1.41421	2.82842
SEM		5.55583	9.59644	1.51522	2.525381	5.55583	1.01015	2.02030
		0.71523	0.01854	0.26755	0.341721	0.28874	0.57086	0.22913
% of antioxidant activity		71.5231	1.85430	26.7549	34.17218	28.8741	57.0860	22.9139
S1		102	361	283	280	247	167	173
S2		113	380	280	283	242	170	170
mean		107.5	370.5	281.5	281.5	244.5	168.5	171.5
SD	C	7.77817	13.4350	2.12132	2.121320	3.53553	2.12132	2.12132
SEM		5.55583	9.59644	1.51522	1.515228	2.52538	1.51522	1.51522
		0.71523	0.01854	0.25430	0.254304	0.35231	0.55364	0.54569
% of antioxidant activity		71.5231	1.85430	25.4304	25.43046	35.2317	55.3642	54.5695

3.3. Descriptive Analysis of the Antioxidant Activity of Three Lipid Samples Using the DPPH Test:

Antioxidants play an important role in protecting against damage caused by free radicals, which are associated with many chronic diseases and cellular changes. Dietary oils and fats are important natural sources of antioxidants [30]. The antioxidant activity of three types of samples from Iraqi markets was compared: sunflower oil (Al-Dar - Sample A), virgin olive oil (Kul Al-Afiayh - Sample B), and animal fat (Abu Ghraib - Sample C), using the DPPH test and various concentrations ranging from 0.0625 to 1 µL. The DPPH test was performed to determine the free radical-fighting capacity of the three samples, and the results were compared with ascorbic acid (vitamin C), a standard antioxidant. Five different concentrations were used (0.0625, 0.125, 0.25, 0.5, and 1) µg/

Absorbance values were recorded, percentage antioxidant activity was calculated, and the mean, standard deviation (SD), and standard error (SEM) were calculated for each sample. The results were presented in a table and graph to represent the variance, as shown in Table 4 and Figure 4. The results showed clear variation in antioxidant behavior among the three samples. **Table4:** Statistical analysis and comparative evaluation of antioxidant activity in samples using DPPH assay.

التركيز µg/ml	(A)	(B)	(C)
0.0625	24.7682	26.7549	25.4304
0.125	22.25165	34.17218	25.43046
0.25	22.2516	28.8741	35.2317
0.5	12.9801	57.086	55.3642
1	4.23841	22.9139	54.5695

Two readings (S1 and S2) were measured, and the mean, standard deviation (SD), and standard error of mean (SEM) were calculated based on Table 3.
The percentage of antioxidant activity was then calculated using the following formula (Table 4)
 %antioxidant activity = ((Acontrol - Asample) / Acontrol) × 100
Absorbance at specific wavelengths for a control sample (distilled water) and for each oil sample at different concentrations. For each concentration،
Where:
A control: average absorbance of the control sample (water).
A sample: sunflower oil (Al-Dar) :
Showed an initial activity of 24.77% at the lowest concentration µg/ml , but it gradually decreased with increasing concentration until it reached 4.24% at the highest concentration (1 µg/ml). This decreasing pattern indicates that the active compounds in sunflower oil lose their efficiency at high concentrations, reducing its effectiveness as an effective antioxidant at high dose

Sample B, virgin olive oil (Kul Al-Afiayh):
Efficiency started at 26.75% at 0.0625 µg/ml , then increased significantly to 57.08% at 0.5 µg/ml , and then decreased to 22.91% at 1 µg/ml. This pattern suggests that virgin olive oil has its maximum activity at intermediate concentrations, and the decrease at higher concentrations may be due to saturation or decomposition of some active compounds with increasing concentration..

Sample C, Animal Fat (Abu Ghraib):

Sample C showed a steady increase in antioxidant activity from 25.43% at 0.0625 μg/ml   to 54.57% at 1 μg/ml. This behavior indicates the stability of the active compounds in animal fat and their continued effectiveness with increasing concentration, making it an effective natural antioxidant at high concentrations.

The statistical data and graph in Figure 4 indicate that both Sample B and Sample C showed greater effectiveness than Sample A, while Sample C performed better at higher concentrations. Sample A and Sample B showed good initial effectiveness, but this effectiveness was not maintained with increasing concentration, reducing their value as a stable antioxidant. The means and standard deviations show relatively stable values, as shown in Table 4, enhancing the reliability of the results. The calculated percentages indicate clear differences in the reaction pattern with DPPH concentration. Based on the tabular data and descriptive statistical analysis in Table 4 and Figure 4, it can be concluded that animal fats have stable and effective antioxidant activity at high concentrations, while virgin olive oil exhibits the best efficacy at medium concentrations. Sunflower oil, on the other hand, showed limited efficacy, which decreased with increasing concentration   .
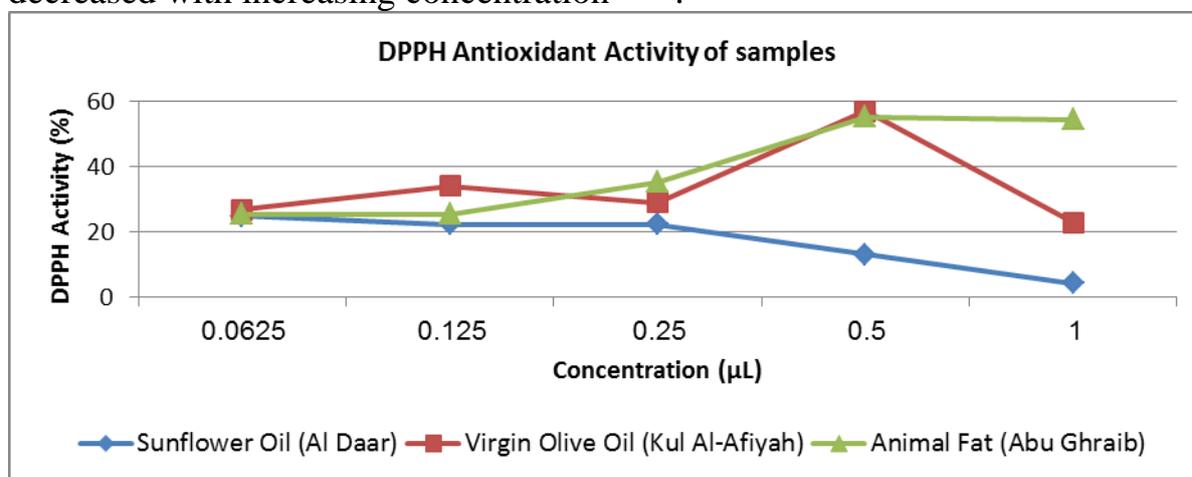
Figure 4: Antioxidant levels curve by DPPH test

4. Conclusion: The current study examined analytical methods for verifying and evaluating the quality of edible fats and oils. These methods included standard methods used by chemists and more advanced methods. Several physical and chemical properties were used to assess the quality of edible free fats, olive oil, and sunflower oil available in the Iraqi market. Fourier transform infrared and gas chromatography-mass spectrometry (GC-MS) techniques demonstrated that fatty acids and many chemical compounds in olive oil and animal fats possess biological activity. This conclusion was confirmed when these oils were tested as antioxidants and through statistical analysis of antioxidant activity. The results

showed that Abu Ghraib animal fat had the highest free radical scavenging capacity, reaching 54.5695%, while virgin olive oil (Kul Al Afiayh Oil) reached 22.9139%, and sunflower oil (Al Dar) reached 4.23841%. This study could be further developed by investigating its antimicrobial, antioxidant, and antifungal activities, as well as it should be noted that animal fats are not suitable as synthetic antioxidants. Their basic structure makes them susceptible to autoxidation when exposed to environmental factors such as heat, oxygen, and light. Animal fats are highly susceptible to oxidation due to their varying levels of unsaturated fatty acids, leading to the formation of oxidative compounds that negatively impact food quality and safety [31]. Although they contain complex organic compounds composed of saturated and unsaturated fatty acids linked to glycerol, they are natural antioxidants, such as carotenoids and fat-soluble vitamins (such as vitamin E). However, animal fats are substances that require antioxidant protection, not antioxidants per se. Animal fats are not used as antioxidants; rather, natural or synthetic antioxidants are added to protect them from spoilage and rancidity. Antioxidants include tocopherol (natural vitamin E), butylhydroxyanisole (BHA), butylhydroxytoluene (BHT), ascorbic acid, and its derivatives [32].

Acknowledgments

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الزيوت والدهون: طرق الكشف للتقييم والتوصيف الكيميائي وتشخيص تأثيراتها المضادة للأكسدة

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مستخلص البحث:

المقدمة: نظرًا لأهمية الزيوت والدهون وارتباطها الوثيق بصحة الإنسان، أصبح من الضروري دراسة مكوناتها الأساسية ووصفها لفهم خصائصها البيولوجية والكيميائية.

الطرق: ركزت هذه الدراسة على توصيف "زيت دوار الشمس (الدار)"، وزيت الزيتون البكر "زيت كل العافية"، و"دهن حيواني – أبو غريب"، باستخدام تقنيات الأشعة فوق البنفسجية-المرئية (UV-Vis)، وقياس الطيف بالأشعة تحت الحمراء بتحويل فورييه (FTIR)، وكروماتوغرافيا الغاز المقترنة بمطياف الكتلة (GC-MS)، بالإضافة إلى دراسة خصائصها المضادة للأكسدة.

النتائج: تراوحت أطوال الموجات بين 200 و400 نانومتر، مع تسجيل أطوال موجية عند 278 و290 و265 نانومتر لكل عينة على التوالي. تم استخدام التحليل الطيفي لتحديد المجموعات الوظيفية على أسطح زيوت دوار الشمس والزيتون. كما استخدم تحليل مكونات الأطياف بالأشعة تحت الحمراء لتحليل المجموعات الوظيفية المختلفة، حيث تم دراسة قمم الامتصاص بين 4000 و500 سم$^{-1}$. وأظهرت الدهون الحيوانية أداءً أفضل عند قياس فعاليتها في منع الأكسدة. إذ سجل "دهن حيواني – أبو غريب" أعلى قدرة على مقاومة الجذور الحرة بواقع 54.5695 %، بينما سجل زيت الزيتون البكر "زيت كل العافية" 22.9139 %، وزيت دوار الشمس "الدار" 4.23841 %. وأشارت النتائج إلى أن العينات المختارة تحتوي على مركبات كيميائية نشطة بيولوجيًا؛ ومع ذلك، أظهرت الدهون الحيوانية خصائص مضادة للأكسدة أعلى بشكل ملحوظ.

الكلمات المفتاحية: "زيت دوار الشمس (الدار)"، زيت الزيتون البكر "زيت كل العافية"، "دهن حيواني - أبو غريب"، كروماتوغرافيا الغاز ومطياف الكتلة ، تحويل فورييه بالأشعة تحت الحمراء

ملاحظة: هل البحث مستل من رسالة ماجستير او اطروحة دكتوراه ؟   كلا