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Physicochemical Characteristics of Some Imported Edible Vegetable Oils in Iraq.

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ABSTRACT

The physicochemical properties (refractive index, Specific gravity, saponification value, Free Fatty Acid content, iodine value, , acid value, peroxide value) of twenty imported edible vegetable oil in shops in Iraq were assessed using standard procedures. When the measurement results were compared with physicochemical properties recommended by the Codex Alimentarius Commission of FAO/WhO , and the specification of Iraq-Babylon Standards. The results showed that some of the oil samples have unacceptable value in comparison with the standards.
Keywords: edible oil, physicochemical properties, AOAC.

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INTRODUCTION

Many people in developing countries, especially children under five years of age suffer from acute or chronic protein and energy shortages. In the current trend of increasing the number of the population, it is expected that by 2017 there will be up to 300 million chronically undernourished people in sub-Saharan Africa [1]. There is definitely a need for food production to keep pace with the increase in the number of the world's population. In order to achieve these national development strategies in many based economy tropical countries on agriculture and biased now towards increasing diversity of food products and consumer in order to alleviate malnutrition and pressure to strengthen and expand based industries on agriculture to ensure that their products are both healthy and safe.

Oils and fats for food has used a variety of other applications since prehistoric times, and was easily isolate the source of the fats and oils found useful because of its unique properties. These are found ingredients to add flavor, lubricity, and texture, and to satiety foods. It has also been found to have a significant role in human nutrition. Fats and oils is the energy source of the highest of the three basic foods (carbohydrates, proteins, and lipids) and carriers for vitamins soluble oil, and many contain essential for health fatty acids that are not manufactured by the human body [2].

There are many reasons for the current push the physical and chemical studies of some edible oils such as sunflower oil, olive oil, corn oil, coconut oil, canola oil, because it is important in the high daily use, cooking, salad, foods and various other industries (such as cosmetics and materials pharmaceutical and lubricants, and medical characteristics ,etc.) [3]. It is the major components of the diet as well as providing a distinctive textures and flavors to foods.

It is intended to study the properties of some of these oil samples through the physio-chemical tests like (refractive index, saponification value, iodine value, peroxide value, percentage of free fatty acid) in Iraqi Babylon region. The study aims to shed more light on the oil acidity and composition of saturated and unsaturated fatty acids .

MATERIALS AND METHODS

Samples of 20 brands of edible oils produced from a variety of Vegetable Oils were purchased from various markets in Babylon Iraq. (Table 1)

Chemicals

Acetic acid (96%) v/v reagent grade, acetone (99.6%), diethyl ether (analytical grade) and ethanol absolute (extra pure) purchased from (MERK, Germany).with carbon tetrachloride, pure, chloroform, extra pure, ethanol (95% v/v), iodine monochloride, glacial acetic acid, methanol (extra pure, assay > 99.5%).
0.10 M KOH solution, potassium iodide solution 10.0% and sodium thiosulfate solution (0.10 N) were purchased from (SIGMA-ALDRICH).

Equipment

A Sartorius digital balance (PL303), Electro mantle (UK) refluxing equipment, and an Abbe (UK) refractometer were used in the determination measurements.

Method

Determination of Peroxide Value

Exactly 2.0g of KI and 40 ml of solvent mixture (glacial acetic acid: chloroform, 2:1 v/v) were added to 2.0g of the oil sample and the mixture was boiled for one minute. The hot solution was poured into a flask containing 40 ml of 5% KIO_3 solution. Few drops of starch solution were added to the mixture and the latter was titrated with 0.025M $Na_2S_2O_3$ solution [4].

Determination of Acid value

Each oil sample (1.0 g) was weighed and dissolved with 50 ml of ethanol in a conical flask. Two drops of phenolphthalein indicator were added and titrated to pink end point (which persisted for 15 minutes) with 0.1 N potassium hydroxide solution (KOH). Acid value was calculated (Equation 1) [4]:

$$C_{17}H_{33}COOH + NaOH \rightarrow C_{17}H_{33}COONa + H_2O \dots\dots \quad (1)$$
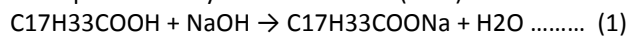
$$\text{Acid value} = \frac{56.1 \ xV \ xC}{m} \dots\dots\dots\dots\dots\dots(2)$$

Where 56.1 is equivalent weight of KOH, V is the volume in ml of standard volumetric KOH solution used, C is the exact concentration in KOH solution used (0.1 N), m is the mass in grams of the test portion (1 g).

Determination of Saponification value

SVs were determined by the AOAC official Method No. 920.160. A 0.1 N KOH solution was prepared with 95 % ethanol and distilled. 5 g of oil sample were weighed in a conical flask, the flask was connected to an air condenser and boiled until the oil was completely saponified, cooled and titrated with 0.5 M HCl using phenolphthalein as indicator [5].

Determination of Iodine value

The AOAC Official Method 993.20 (Wijs method) was used to determine the Iodine values. The sample was taken nearest to 0.002 g according to its IV and was dissolved in 30 mL of 3:2 v/v CH_3COOH and cyclohexane solution, 50 mL of Wijs solution was added and kept undisturbed in the dark following the IV scale, after that time it was titrated with a 0.1M $Na_2S_2O_3$ solution.[6].

Determination of the Free Fatty Acids of the Oil Samples

To 20 ml of ethanol : diethyl ether (1:1 v/v) mixture, 1ml of 1% phenolphthalein solution was added and the mixture was neutralized using 0.10M NaOH solution. Then 3g of each oil sample was added to the neutralized mixture and titrate against 0.10M NaOH solution with constant shaking until a pink colour developed and persisted for 10 minutes. The titer values were used to obtain the free fatty acid value.[6].

Determination of Specific gravity

specific gravity bottle was used in measuring the density/specific gravity The specific gravity of oil Sample is the ratio of the weight in air of a given volume of the oil at a define temperature to that of the same volume of water at same temperature Cleaned, dried pycnometer was weighed. It was filled with water maintained at 20 C^0 and weighed again. The bottle was emptied, dried and filled with oil and weighed. The value was calculated using equation (3)

$$\text{Specific gravity} = \frac{\text{Weight of oil}}{\text{Weight of water 20 } C^0}$$

Determination of the refractive indices, η 40

D, (RI), of the oils samples were measured using the Abbe refractometer connected to a thermostatically controlled water bath that maintained the temperature of the refractometer at 40 ± 0.1 C^0. The determination of refractive indices was done following the procedures of Cocks and van Rede (1997) [7].

Table 1: Edible oil and manufacturer names ,collected off shelves from shops region Babylon – Iraq.

Names of sample oil	manufacturer country	Date of production	Date of Expiry
1. Alkhair	Turkey	3/2015	4/2016
2. Orkide	Iran	1/2015	3/2017
3. Bizce	England	4/2015	10/2016
4. Sandy	Turkey	2/2015	6/2017
5. Sunflower oil	Iraq	1/2015	8/2016
6. Noor Oil	Turkey	2/2014	2/2016
7.Golden cup	Saudi Arabic	6/2014	9/2016
8.altunsa oil	Turkey	9/2014	4/2016
9. Palm oil	Iraq	5/2012	5/2017
10.Olive oil	Turkey	8/2013	7/2015
11. norrse oil	Saudi Arabic	3/2014	5/2015
12.Ottaman oil	Turkey	3/2015	9/2017
13.jena oil	Iraq	2/2014	3/2016
14.Bimoli	Turkey	1/2015	1/2017
15. Canola oil	Turkey	6/2014	10/2016
16. Castor oil	Saudi Arabic	2/2014	3/2017
17. Coconut oil	Turkey	5/2013	3/2017
18.family oil	England	8/2013	9/2016
19.zakera oil	Turkey	7/2014	8/2016
20.Jamela oil	Turkey	4/2015	4/2016

RESULTS AND DISCUSSION

Table 2: The results of the physicochemical properties of the Twenty (20) EDIBLE oil samples analyzed.

| Sample (Brand)	acid value mg KOH/g	Peroxide value (meq.peroxide/kg)	Saponification Value (mg KOH / g)	Iodine value (g $_{I2}$ / 100 g sample)	FFA % Oleic acid
1. Alkhair	3.46	12.0	186.54	112.444	0.421
2. Orkide	0.46	5.45	183.13	111.043	0.35
3. Bizce	0.30	4.47	201.49	87.738	0.321
4. Sandy	0.43	4.39	214.05	84.638	0.231
5. Sunflower oil	0.55	5.92	177.78	109.860	0.278
6. Noor Oil	0.66	3.01	192.48	108.658	0.389
7.Golden cup	2.3	5.06	194.85	42.553	0.156
8.Turkey	1.50	9.79	189.55	109.380	0.122
9. Palm oil	1.11	6.15	192.07	105.231	0.543
10.Olive oil	0.44	7.56	191.44	110.116	0.678
11. Norse oil	3.54	10.35	191.46	189.638	1.442
12.Ottaman oil	0.99	7.77	192.55	87.738	0.859
13.jena oil	2.44	5.19	197.87	102.44	0.921
14.Bimoli	0.44	2.16	198.72	111.043	1.245
15. Canola oil	1.66	2.89	196.95	108.658	0.943
16. Castor oil	0.90	9.99	205.05	67.738	2.543
17. Coconut oil	2.34	3.99	201.4	84.638	0.441
18.family oil	0.77	7.71	186.52	109.380	1.377
19.zakera oil	2.51	3.20	189.55	101.231	0.772
20.Jamela oil	1.61	8.82	192.26	110.116	0.954

Acid value

Acid value (AV) is an important indicator of vegetable oil quality. AV is expressed as the amount of KOH (in milligrams) necessary to neutralize free fatty acids contained in 1.0 g of oil. But the free fatty acid (%FFA) content is a conventional expression of the percentage mass-fraction of total fat. According to the

nature of the fat it is expressed as lauric acid for coconut, palm kernel, and similar oils, as palmitic acid for palm oil and as oleic acid for all other oils .In the view of the results shown in Table 2, all the samples have acceptable AV and %FFA values except samples Alkhair oil and zakera oil have unacceptable higher values and this is may be due to the presence of higher free fatty acids as rancid oil which is hazardous for human uses. [8]. Edible Vegetable Oils from Iraq main market has the highest acid value of 3.46 ± 0.30 . Acid value determination is often used as a general indication of the condition and edibility of the oil. This is because an increase in acid value is accompanied by development of objectionable flavours and odours.

Peroxide value

Peroxide value is an indication of the extent of oxidation suffered by oil. High peroxide value indicates high degree of unsaturation, which in turn responsible for oxidative rancidity [9]. The test sample is first dissolved in mixture of chloroform and acetic acid (2:3). By flowing nitrogen gas through the sample to dispel residual oxygen, add potassium iodide, and then titrate free iodine with 0.01mol/ sodium thiosulfate. The endpoint is determined by the maximum inflexion point on titration curve

$$I2+ 2Na2S2O3 \rightarrow Na2S4O6+ 2NaI\ldots\ldots\ldots\ldots\ldots(3)$$
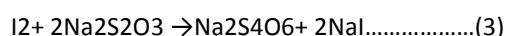
Initial peroxide values for the edible oils and fat ranged between 2.1 and 12.0 meq/kg-oil. The highest value was found in Alkhair oil (12.0 meq/kg-oil) and the lowest value from Bimoli (2.1meq/kg-oil). The values for all the edible oils were within the FAO/WHO and TBS standards for edible vegetable oils. In general the peroxide value increased with storage time. Oils exposed to both atmospheric oxygen and light showed a much larger increase in peroxide value during storage.   .

Saponification Value

Saponification value is an indication of the size or nature of fatty acid chains esterified to glycerol. and gives a measure of the average length of the fatty acid chain that makes up a fat[10]. In combination with acid values, saponification values are useful in providing information as to the quantity, type of glycerides and mean weight of the acids in a given sample of oil. Saponification is only of interest if the oil is for industrial purposes, as it has no nutritional significance. But due to the fact that each fat has within the limits of biological variation, a constant fatty acid composition, determination of the saponification value is a reasonable means of characterizing the fat[9]. The results also show that highest saponification value was recorded with the oil from Sandy with 214.05mg KOH/g, indicating that the oil can be used industrially for making soap.

Iodine value (IV)

Iodine number" or "iodine index") in chemistry is the mass of iodine in grams that is consumed by 100.0 of unsaturation contained in fatty acids. This unsaturation is in the form of double bonds which react grams of a chemical substance. One of the applications of the iodine number is the determination of the amount with iodine compounds. All the edible oils purchased, IV was found to be very high. This is an indication of high saturation in these oils and thus they become more vulnerable to oxidation. The IV of an oil does not indicate the position of the double bonds or amount of olefinic carbon but rather it provides an overall status of unsaturation of the oils so it is not possible to point out the position of double bond(s) which are more susceptible to oxidation[10].

The results show in Table 2 that Iraq main market and Babylon area oils have low iodine value of 42.553 and 67.738 respectively indicating their low quality. The vegetable oil has the highest iodine value of 117.116 g/100g, indicating that the fatty acid presence is unsaturated, especially oleic oil. This is a measure of fat or oil stability and resistance to oxidation[11].

Free Fatty Acid

Free fatty acid is the percentage by weight of a specified fatty acid (e.g. percent oleic acid). The edible oils had varied FFA content. This is attributed to the natural variation from one variety and sample to another, moisture contents, refining and deodorization[12]. The largest initial values were obtained in Alkhair oil (3.46

mg/g-KOH) and the lowest in Bizce (0.30 mg/g-KOH). Free Fatty Acid values were lower for all oils as compared to the values recommended by FAO/WHO . This might be attributed to the variation in the refining and deodorization processes used and also the moisture contents. High levels of free fatty acids especially linoleic acids are undesirable in finished oils because they can cause off-favours and shorten the shelf life of oils. The quantity of free fatty acid in oil is an indicator of its overall quality.

Table 3: the results of the Refractive index (RI) and Specific gravity(Sp.gr) of Edible oil samples at 40 C^0

Names of sample oil	RI/at 40C^0	Sp.gr/at 40C^0
1. Alkhair	1.475	0.891
2. Orkide	1.467	0.882
3. Bizce	1.463	0.925
4. Sandy	1.469	0.921
5. Sunflower oil	1.470	0.934
6. Noor Oil	1.458	0.921
7.Golden cup	1.466	0.944
8.Turkey	1.469	0.994
9. Palm oil	1.474	0.933
10.Olive oil	1.445	0.965
11. Norse oil	1.479	0.977
12.Ottaman oil	1.491	0.939
13.jena oil	1.465	0.971
14.Bimoli	1.429	0.949
15. Canola oil	1.491	0.933
16. Castor oil	1.488	0.899
17. Coconut oil	1.472	0.971
18.family oil	1.460	0.955
19.zakera oil	1.471	0.963
20.Jamela oil	1.464	0.962

The Refractive index (RI)

The refractive indices of the oils investigated, RI, at 313.15 K are given inTable 3.The Edible oils exhibited different refractive indices. The physicochemical values for oils of the same type though from different manufacturers were quite similar. This trend suggests that refractive index could be used in the preliminary identification of the oils and fat[12]. Refractive index plays an important role in many branches of physics, biology and chemistry [13]. The refractive index of fats and oils is sensitive to their composition. In fats RI increases with increasing chain length of fatty acids in the triglycerides or with increasing unsaturation. This makes it an excellent spot test for uniformity of compositions of oils and fats [14].

Table 3 shows that all vegetable oil samples have different RI values This is may be to the fact that RI values increase with chain length of fatty acids in the triglycerides or with degree of unsaturation [15].

Specific gravity (Sp.gr)

Specific gravity is the comparison of the weight of the oil to that of water having the same volume and at a given temperature. Specific gravity measurement can be used in awide variety of industries. It is particularly useful because it allows access to molecular information in a non-invasive way.[16] Studies have shown that the specific gravity of different refined oils varies with their molecular weights which are affected by refining processes[17]. There was significant difference between the specific gravity of the different oil samples. The range is from 0.882-0.994.In the first density may not seem an exciting physical property to many technologists, but it is very important in the trading of oils since shipments are sold on a weight basis but measured on a volume basis [18]. Table 3 shows different values of Sp. gr. that may be attributed to the different fatty-acid composition , different total solid content and different degree of saturation .

CONCLUSION

In the present study various physico-chemical characteristics (RI, sp. gr., saponification value, Free Fatty Acid content, iodine value, , acid value, peroxide value) have been studied and may be used for quality control of the different Edible oil sample. The measurement of the mentioned physico-chemical characteristics indicate that Alkhair oil   and Norse oil have high value of rancidity among all vegetable oil samples and this is may be attributed to the presence of higher free fatty acids, degree of unsaturation, hydrolysis of triglycerides, storage and date of expire.

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