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Comparison of some physicochemical properties of edible vegetable oils available in Al-Najaf, Iraq

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Abstract---This study was conducted at the laboratories of chemistry Department / College of Science/ Al-Nahrain University, Iraq. The primary determinants of edible oils' acceptance, preferred uses, and market value are their purity and stability. Therefore, the goal of this study to measure some of a set physical and chemical properties for four (canola oil, sunflower oil, corn oil and olive pomace oil) before using .The main physico-chemical properties determined for oils were Refractive index(RI), Viscosity (μ), Iodine value (IV) , *P*-Anisidine value (P-AV) and Peroxide value (PV). The values Refractive index were 1.4721, 1.4735, 1.4730 and 1.4685 respectively .While, viscosity (μ) were 78.44, 60.52, 63.79 and 79.91 cps respectively. IV was 112.75, 109.13, 102.61 and 96.43 (g I_2/100g) for the four oils respectively .*P*-AV were 0.60, 2.59, 0.71 and 2.63 for four oils respectively. PV was 1.98, 2.19, 5.05 and 6.03 (Meq.O_2/Kg) respectively. These results showed that the oil samples have acceptable values when compared with the range recommended by FAO/WHO standards.

Keywords---Comparison, Physicochemical, Properties, Edible vegetable oils.

Introduction

Edible vegetable oils are vital constituents in our daily diet, which provide energy and as a carrier of fat-soluble vitamins (A, D, E and K). It is consist of triglycerides between 95 and 99%. They can also contain soluble phytosterols, natural pigments and phospholipids from 1 to 5% (Evrard *et al.*, 2007) .Edible vegetable oils are used in food, both in cooking and as supplements play an important role in the body as carriers of essential fatty acids which are not synthesized in the body but are needed through the diet to maintain the integrity

of cell membranes**.** This project includes four types of edible vegetable oils such as canola oil, sunflower oil, corn oil and olive pomace oil, which are marketed as healthy and heart-friendly. Several factors affect the edible vegetable oils quality such as agronomic techniques, seasonal conditions, sanitary state of drupes, ripening stage, harvesting and carriage systems, method and duration of storage and processing technology and it is determined by different analytical methods in order to assess the stability of oil and to avoid possible adulterations (Shaik , 2008; Medhat and Aljanabay, 2022).The purity and stability of edible oils are the main factors that influence their acceptability, desirable use and market value. A number of factors have been reported to affect oil quality (Justyna and Waldermar, 2011). To meet the quality and composition standards, oil & food industries use certain oil physico-chemical properties to maintain the quality, such as Refractive index(RI), Viscosity, Iodine Value (IV), *P*-anisidine value (*P*-AV) and Peroxide Value (PV). The objective of this project is to measure some of a set physical and chemical properties for all oils using in this study before using.

Materials and Methods

Samples collection

Samples of four fresh edible oils (canola oil, sunflower oil, corn oil and olive pomace oil) used for study were purchased from local markets located in Al-Najaf Governorate, Iraq. These oils were selected because they are readily available worldwide and most consumed locally by homes and restaurants then coded with detail information. Until analyses, all oils were maintained in the dark, at room temperature (Hadi and Aljanaby, 2022).

Physical properties determination

The refractive index of selected oils was measured at 20°C using an Abbe's refractometer according to the Food Safety and Standards Authority of India (2015). The viscosity (μ) of the four edible vegetable oils was determined by an (Ostwald viscometer) according to O'Brien (2009)**.**

Chemical properties determination

Iodine value determination was carried out using the method described by A.O.A.C (2000). *P*-Anisidine value was determined in triplicate for each of the samples based on Tompkins and Perkins (1999)**.** Peroxide value determination was carried out using the method described by Ranken (1988)**.**

Result and Discussion

Some physical and chemical properties of canola oil ,sunflower oil, corn oil and olive pomace oil before using have been extensively investigated, reported in terms of mean plus standard deviation (N = 3).

Determination of the physical properties

Refractive index

The refractive index (RI) is the ratio of the speed of light in a vacum to the speed of light through a given material (Jack *et al.*, 2013). The values of the refractive index indices of the four oils at 20 °C are depicted in Table (2). The highest value of RI was (1.4735) for sunflower oil which slightly above the level recommended by FAO/WHO (1.467-1.469), while the lowest value was (1.4685) for olive pomace oil which nearly in line with the level advised by FAO/WHO (1.4680-1.4707) within Table (1). The increase in chain length of fatty acid present in oil tends to increase the refractive index of oils. The highest value of RI obtained for Sunflower oil probably attributed to the presence of high content of linoleic acid (Nikolova1 *et al.*,2014) .

Viscosity (μ)

The viscosity of edible vegetable oil is determined by the nature and arrangement of fatty acids on the glycerol backbone. Results tabulated in Table (2) shows that olive pomace oil and canola oil were the most viscosity (79.91and 78.44) cps, respectively. While, sunflower oil was the least viscous 60.52 cps at 20 °C. olive pomace oil and canola oil contain relatively more percentage of saturated components while sunflower oil is rich in unsaturated fatty acids (Musa *et al.*, 2012). Its value increases with increasing degree of saturation (Nikolova *et al.*,2014; Fazal *et al.*, 2015). These results agree with Mengistie *et al.* (2018) which found that sunflower oil has the lowest viscosity among the oils studied and attributed this to its richness with a high content of unsaturated acids.

Table 1: Physical properties set by FAO/WHO as standard for four edible vegetable oils (Asean Manual for food analysis, 2011)

Physical pr. / Oil type	Refractive index	Viscosity (cPs)
Canola oil	1.465 -1.469	72-82
Sunflower oil	1.467-1.469	55-61
Corn oil	1.472-1.474	45-65
Olive Pomace oil	1.4680-1.4707	70-84

Table 2: Physical properties set for four crude edible vegetable oil samples during study at 20 °C

Physical pa. / Oil type	Refractive index Mean ± SD	Viscosity(cps) Mean ± SD
Canola oil	1.4721±0.00036	78.44±0.056
Sunflower oil	1.4735±0.0002	60.52±0.03
Corn oil	1.4730±0.00036	63.79±0.036
Olive Pomace oil	1.4685±0.00044	79.91±0.115

Determination of the chemical properties

Iodine value (IV)

The iodine value is proportional to the degree of unsaturation (double bonds). Hence, higher iodine values correspond to oils rich in polyunsaturated fatty acids whereas oils with low iodine value have a lower degree of unsaturation The results in table (4) shows different values of Iodine number this is normal because they are different in their origins and sources .The highest iodine values were (112.75 and 109.13) g I_2/100g for canola oil and sunflower oil respectively .While, the lowest value was 96.43 g I_2 /100g for olive pomace oil . When comparing the results with those in Table (3) shows the iodine values for all oil samples were within the range recommended by FAO/WHO Standards (103-134) g I_2/100g .Olive pomace oil was slightly above the level recommended by FAO/WHO (75-92) g I_2/100g . Generally, iodine value, can be used to evaluate the purity and quality of oils (Mohammed, and Ali, 2015). The vegetable oil has the highest iodine value indicating that the fatty acid presence is unsaturated, especially oleic oil. This is a measure of oil stability and resistance to oxidation. These results agree with Al- Majidi and Bader (2015) which found that sunflower oil and canola oil has the near iodine values were (109.860 and 108.658) g I_2 /100g respectively. It is considered that oils that are rich in saturated fats may raise blood cholesterol and increase the risk of heart disease, while unsaturated fatty acids have been reported to exhibit health benefits (Burdge and Calder, 2005).

Table 3: Chemical properties set by FAO/WHO as standard for four edible vegetable oils (Asean Manual for food analysis,2011)

Chemical pr. / Oil types	Iodine value (g I_2/100g)	*P*-Anisidine value	Peroxide value (Meq.O2/Kg)
Canola oil	110-126	2-10	2-10
Sunflower oil	120-134	2-10	2-10
Corn oil	103-128	2-10	2-10
Olive Pomace oil	75-92	2-10	2-10

.

Table 4: Chemical properties set for four crude edible vegetable oils

Chemical pr. / Oil type	Iodine value (g I_2/100g)	P-Anisidine value	Peroxide value (Meq.O_2/Kg)
Canola oil	Mean ± SD	Mean ± SD	Mean ± SD
	112.75±0.337	0.60±0.036	1.98±0.026
Sunflower oil	109.13±0.324	2.59±0.164	2.19±0.026
Corn oil	102.61±0.478	0.71±0.006	5.05±0.036
Olive Pomace oil	96.43±0.348	2.63±0.231	6.03±0.026

_P_-Anisidine value (_P_-AV)

P-anisidine value is a measurement of aldehyde content in an oil and the level of secondary oxidation that has occurred, is used as an indicator of quality (Gunstone , 2011) . The results in table (4) shows different values of *P*-anisidine this is due to different in their methods and duration of storage also their origins and sources .The highest *P*-AVwere (2.63 and 2.59) for olive pomace oil and sunflower oil respectively .While , the lowest value was (0.71 and 0.60) for corn oil and canola oil respectively . When comparing the results with those in Table (3) shows the *P*-AV for the olive pomace oil and sunflower oil samples were within the range recommended by FAO/WHO Standards (2-10) while, corn oil and canola oil was less than the level recommended by FAO/WHO (2-10) . Raza *et al.*(2009) found that the *P*-AV for sun flower was 1.45 increased to 10.03 with an increase in storage time under both auto- and photo oxidation conditions. The importance of this test lies as a measure of secondary oxidation products, *P*-AV is used instead of, or together with PV to assess thermally stressed oils. Also may be used to accelerate storage tests to investigate commercial fat samples it was found to be a good predictor of storage stability (Gordon,2001).

Peroxide value (PV)

Peroxide value is used as a measure of the extent to which rancidity reactions have occurred during storage and it is used as a good criterion for the prediction of the quality and stability of oils (Nangbes *et al.*, 2013). It's clear from the results tabulated in Table (4) that the peroxide values for all oils range from (6.03 -1.98) Meq.O2/Kg. Olive pomace oil and corn oil (6.03 and 5.05) exhibited higher values than the sunflower oil and canola oil (2.19 and 1.98) Meq.O2/Kg respectively. Therefore, these oils are relatively more susceptible to oxidative rancidity than the other oil samples. However, comparing the results with those in Table (3) shows the peroxide value for all oil samples were within the range recommended by FAO/WHO Standards (2-10) .In general, high peroxide value could be resulted from high degree of unsaturation and found to increase with the storage time, temperature, light and contact with atmospheric oxygen (Mohammed and Ali, 2015, Mengistie *et al.*,2018).

Conclusion

In this study various physico-chemical characteristics (RI, viscosity, IV, P-AV and PV) have been studied and may be used for quality control of the different edible vegetable oil samples (canola, sunflower, corn and olive pomace). The measurement of the mentioned physico-chemical characteristics indicated that the oil samples have acceptable values when compared with the range recommended by FAO/WHO standards

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