DETERMINATION OF SOME PHYSICO-CHEMICAL PARAMETERS OF THREE VARIETIES OF ALIMENTARY OIL

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Abstract. *Edible oils are vegetable fats, which are used in food in various forms: for frying, in salads, in doughts and cakes, etc. Among the many characteristics that are standardized for oils, some are particularly important for traders and especially for consumers, namely: colour, smell, density, viscosity, melting point, smoke point, the boiling point, flame behavior, light resistance, resistance to rancidity, etc. The purpose of this work is to determine some physico-chemical parameters of three varieties of domestic edible oil: sunflower, soybean and rapeseed oil. The following physico-chemical parameters were determined: refractive index, density, viscosity, surface tension and acidity (as oleic acid). The analyzed physicochemical parameters shows different values, depending on the nature of the analyzed oil: 1.4713 (sunflower oil) – 1.4740 (soybean oil), for refractive index; 0.9114 (rapeseed oil) - 0.9132 (sunflower oil) g/cm3 – for density; 33.0399 (soybean oil) – 34.5011 (sunflower oil) cp – for viscosity; 24.31 (sunflower oil) - 28.71 (soybean oil) dyn/cm - for surface tension; 0.12 (soybean) - 0.26 (rapeseed oil) % oleic acid – for acidity. The values of the physico-chemical parameters of the analyzed vegetable oils show that they are suitable to be used in food. In addition, the analyzed parameters could be used to identify and differentiate oil varieties.*

Keywords*: alimentary oil, physico chemical parameters, edible oil varieties*

INTRODUCTION

Vegetable oils and fats play an important role both in food, as well as raw material for different industrial branches. It is known that vegetable oils, along with fats, are indispensable components of our diet and perform a number of vital functions in maintaining a healthy human body (CALUGAR et AL., 2024). Vegetable oils are also raw materials for a number of products used for industrial purposes (emulsifiers for the food industry, textile auxiliaries, lubrificants and stabilizers in the plastics processing industry) or in the household (soaps) Vegetable oils can be obtained by pressing or extraction with solvents, after which they are purified by refining (STOIN, 2008; APARICIO and GARCIA-GONZALEZ, 2009). In nature, fats can be concentrated in plant tissue, in seeds, germs and in pulp and in the core of fruits. The oil content in these parts of the plant is variable and low (1-5%). Only in oleaginous plants, cultivated especially for the production of seeds, the oil content reaches up to 55%. The oil plants in which the oil is concentrated in the seeds are: soybean, rape, sunflower, and plants producing oil fruits: olive, palm, coconut. Fats are part of the group of lipids and represent complex mixtures of glycerides. Among the three groups of basic substances, protein substances, carbohydrates (sugars) and lipids (fats) that enter in the human diet, lipids occupy the first place in terms of the energy value released in the body, during the assimilation process (GUNSTONE, 2002). Along with carbohydrates and proteins, the basic nutrients for the body, they provide energy, protect against the cold, ensure the absorption of fat-soluble vitamins and serve as flavor carriers. The energy role consists in providing of 9.2 kcal for every gram of lipids consumed, while the assimilation of the same amount of carbohydrates or proteins results only 4.1 kcal each (BANU, C., 2003). Edible oils become unhealthy when they are consumed in excess or when the quality of the cooking oil is inadequate. Among the relevant parameters for establishing the nutritional quality of oils, a series of organoleptic and physicochemical parameters can be mentioned, such as: color, smell, density, viscosity, melting point, smoke point, boiling point, flame behavior, light resistance , resistance to rancidity, etc. (BHUKYA, et

AL., 2020; KUMARA et AL, 2016). So, for selecting a good type of pure edible oil we have to take into account its physico-chemical properties. Taking into account those presented above, this work aims to determine some physico-chemical parameters of three varieties of autochthonous vegetable oil sold in local specialty stores.

MATERIAL AND METHODS

In the experimental part, three types of edible oils commonly used in the food industry for the preparation of food and culinary products were analyzed from the point of view of their physico-chemical and nutritional characteristics. The analyzed oil assortments in these paper are local, autochthonous oils such as soybean, rapeseed and sunflower oil purchased from the local markets in Timisoara (Romania). The purpose of the paper was to analyze and compare some physico-chemical characteristics like refractive index, relative density (ρ_r), dynamic viscosity (η), superficial tension(σ), and also acidity index in case of the three vegetable oils. Three sets of samples corresponding to each type of edible oil were formed for each of them, determining the mentioned parameters. Experimental determinations were carried out in accordance with the given recommendations (COZMA et AL., 2019). The refractive index was obtained using the refractometric method, with the Abbe refractometer corrected to the equivalent reading at 20^{o}C (AOAC, 2000). Relative density determination was made using the pycnometric method by weighing the analytical balance, for the dynamic viscosity were used the Ostwald type viscometer, and for the surface tension coefficient has been used stalagmometric method). The free oils acidity is an important indicator due to the free fatty acids present in the product. The acidity index represents the amount of potassium hydroxide, in mg, required to neutralize free fatty acids from one gram of product (POIANA, 2005)

RESULTS AND DISCUSSIONS

The obtained results of the physico-chemical characteristics of alimentary (edible) oils taken in the experiment are presented in table 1 and figures 1-2.

Table 1

The physico-chemical characteristics of some food edible oils sold in local markets

Oil types	Specification	Analyzed parameters				
		Refractive index	Density, g/cm^3	Viscosity, cp	Surface tension, dyn/cm	Acidity, % oleic acid
Sunflower oil	Limit	1.4702-1.4721	0.9123-0.9143	34.2011-34.7967	23.75-24.81	0.12-0.21
	Mean values	1.4713± 0.7x10^{-3}	0.9132± 0.82x10^{-3}	34.5011± 0.24	24.31± 0.44	0.17± 0.04
Soybean oil	Limit	1.4728-1.4753	0.9120-0.9138	32.6860-33.6138	27.99-28.99	0.08 - 0.16
	Mean values	1.4741± 1.25x10^{-3}	0.9129± 0.73x10^{-3}	33.0399± 0.41	28.71± 0.51	0.12± 0.12
Rapeseed oil	Limit	1.4711-1.4730	0.9109-0.9121	32.9698-34.4769	23.80-24.95	0.19-0.34
	Mean values	1.4721± 0.77x10^{-3}	0.9114± 0.9114x10^{-3}	33.7241± 0.62	24.39± 0.47	0.26± 0.06

From data presented in table 1 can be observed that for the utilized edible oils, their values are different from one category to another. The analyzed physicochemical parameters

shows different values, depending on the nature of the analyzed oil: 1.4713 (sunflower oil) – 1.4741 (soybean oil) for refractive index; 0.9114 (rapeseed oil) - 0.9132 (sunflower oil) g/cm3 – for density; 33.0399 (soybean oil) – 34.5011 (sunflower oil) cp – for viscosity; 24.31 (sunflower oil) - 28.71 (soybean oil) dyn/cm - for surface tension; 0.12 (soybean oil) - 0.26 (rapeseed oil) % oleic acid – for acidity.

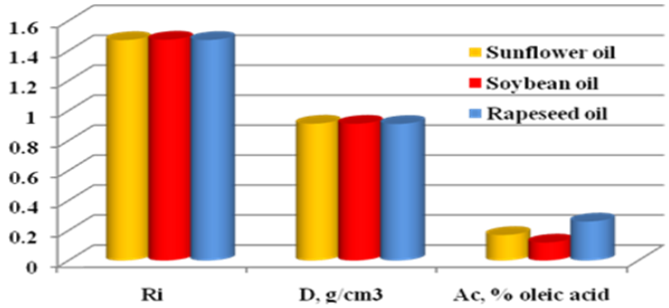

Figure 1. The refractive index, relative density and acidity for the three analyzed oils
Ri - Refractive index, D – density, Ac - acidity

The evaluation of the refractive index as a quality parameter helps to differentiate between different types of vegetable oils or fats. Different oils and fats afford their characterization by quantification the refractive index, in a short time. These measurements can provide a perspective on their quality because any change in their optimal composition will also affect the value of the refractive index (APARICIO and GARCIA-GONZALEZ, 2009). High quality oils have the inscription of refractive index and density, so the degree of variation for real values may indicate a relative questionable purity (NICHOLS and SANDERSON, 2003). Refractive index values for the three analyzed oil samples at 25℃ is in the range 1.4713 (sunflower oil) – 1.4741 (soybean oil). Regarding the refractive index, the smallest value (1.4702) was obtained in case of vegetal sunflower oil and the biggest value (1.4753) for the soybean oil.

Oils density varies from one species to another, and for the same type of oil with storage conditions and climatic conditions in which the plant is developed. The minimum of the relative density values of the investigated oils, at room temperature of 25°C, is 0.9114 in case of rapeseeds oil and the maximum values was obtained 0.9132 for sunflower oil. The oils density varies according to each type of oil and also with the temperature (NEAGU et AL., 2013; DAVIES, 2016). Compared to water, which has a density of 1.00 g/ml, oils are less dense.). Many studies show that oils with lower density values are highly appreciated by the consumers.

Viscosity is considered a significant physical property for the quality of liquid systems. Viscosity mainly gives indications related to the fluidity degree of oils. From table1, the minimum values of the dynamic viscosity are 34, 0399 cP in case of soybean oil while the maximum viscosity values are 34.5011 cP for the sunflower oil. This can be correlated to the contribution of saturated fatty acids. Generally, the oils have a Newtonian fluid behavior, the saturated fatty acid content playing a major role in the viscosity size (MOMIN and THAKRE, 2015). All edible oils consist of triglycerides with a variety of fatty acids that differ depending on chain length, saturation degree and position, as well as the geometry of the double bond in

the carbon chain (GUNSTONE, 2002; DAVIES, 2016). The viscosity of edible vegetable oils increases with the chain length of triglyceride fatty acids and decreases with unsaturation (GELLER and GOODRUM, 2000). The viscosity of sunflower oil is higher than of the rapeseed and soybeans oils.

The free acidity oils studied was determined according to STAS 145-67. Acidity is determined by direct titration of the oil sample in an alcoholic medium, against a standard solution of potassium hydroxide, in the presence of phenolphthalein as an indicator (DOROBANȚU and BECEANU, 2007). The values of free acidity values for the analyzed oils are between 0.12 (soybean) - 0.26 (rapeseed oil) % oleic acid. A low level of acidity is a sign of a high quality of the oil (shows that the oil is fresh or it was preserved in good conditions, with stability, having a good taste and smell). This kind of oils are recommended for consumption. A high acidity shows an inferior quality of the oil, bad smell and taste.

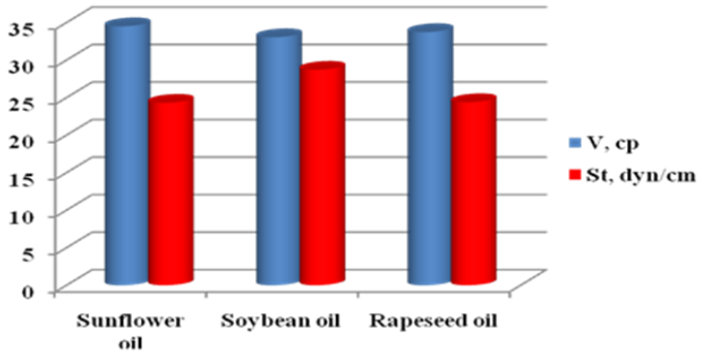

Figure 2. The viscosity and surface tension of some edible oils.
V – Viscosity, St - Surface tension

The ratio between the surface force and the length of the contour on which it acts is called the coefficient of surface tension (or surface tension) (COZMA, 2019). The surface tension values of the oil types, analyzed at 25°C, are in the range of 24.31 (sunflower oil) - 28.71 (soybean oil) dyn/cm. It is shown that, soybean oil contains more fat compared to sunflower oil. The high surface tension of the oil means less spreading of the oil on the surfaces and consequently more energy loss. With an increase in temperature, the surface tension within the limits of a specific concentration, decreases.

As can be seen from table 1 and from figures 1-2, the physico-chemical parameters present values within concentration limits depending on the assortment of edible oil analyzed. The average values of the refractive index, density, viscosity, surface tension and acidity: 1.4713 - 1.4741, 0.9114 - 0.9132 g/cm^3, 33.0399 – 34.5011 cp, 24.31 – 28.71 dyn/cm, and 0.12 – 0.26 % acid oleic, shows that the analyzed oils are comparable to the edible oils used in the consumption. Therefore, these oils can be used for cooking or in other food formulas. It is desired that these parameters can be used to identify the varieties of food oils from oil mixtures. Mean values of determined of refractive index, density, viscosity, surface tension and acidity (table 1) show that they could be used to identify and differentiate these three types of oils sold in local markets. It is desired that the values of these parameters can be used to identify the varieties of edible oils from oil mixtures.

CONCLUSIONS

Being a rich source of energy, vegetable oils from seeds constitute, along with carbohydrates, proteins, vitamins and minerals, the main essential nutrients of a healthy diet.

The physicochemical parameters: refractive index, density, viscosity, surface tension and acidity of the analyzed vegetable oils represents important criteria in determining the qualitative profile and choosing the suitable oil for proper consumption. Therefore, it is necessary to monitor the oil quality parameters.

The soybeen oil is more recommended for consumption grace of the measured parameters (higher density, higher surface tension, low acidity).

The average values obtained for the determination of the physico-chemical parameters refractive index, density, viscosity, surface tension and acidity of the analyzed food oils have specific values depending on the oil assortment.

The values of the physico-chemical parameters of the food oils analyzed: sunflower, soybean and rapeseed are comparable with the data from the specialized literature and can find applications in different food formulas.

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